United States Department of Agriculture

Soil Conservation Service

In cooperation with Texas Agricultural Experiment Station and Texas State Soil and Water Conservation Board

Soil Survey of Archer County, Texas

How To Use This Soil Survey

General Soil Map

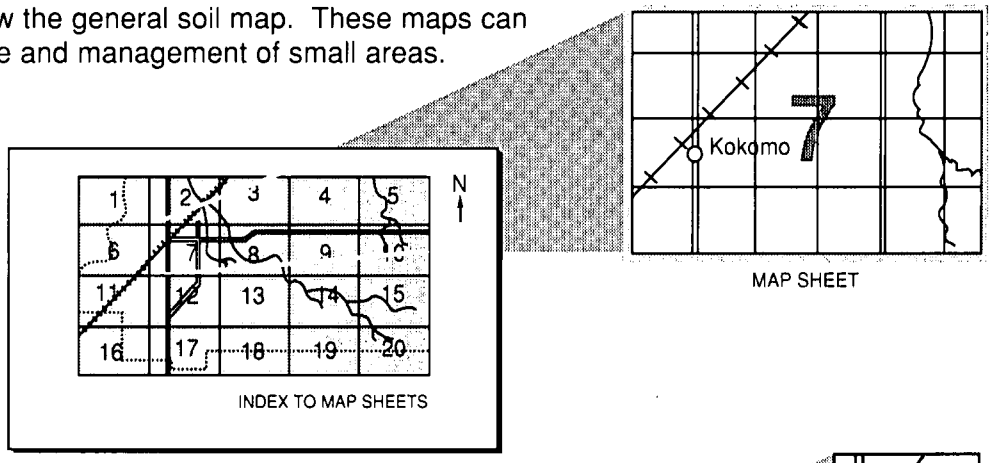
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

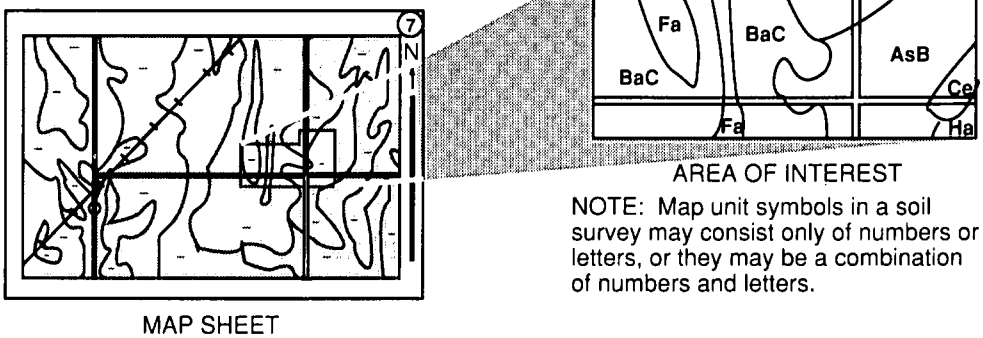
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This soil survey was made cooperatively by the Soil Conservation Service, the Texas Agricultural Experiment Station, and the Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the Little Wichita Soil and Water Conservation District.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, sex, religion, marital status, handicap, or age.

Cover: Hereford cattle grazing on native pasture in an area of Deandale silt loam, 0 to 1 percent slopes.

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Issued April 1995

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Archer County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Harry W. Oneth
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Soil Survey of Archer County, Texas

By Jerry J. Daigle, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Texas Agricultural Experiment Station and the Texas State Soil and Water Conservation Board

Archer County is in north-central Texas (fig. 1). It has an area of 592,710 acres, or 926 square miles. It is bordered on the north by Wichita County, on the east by Clay and Jack Counties, on the south by Young County, and on the west by Baylor County. Archer City, the county seat, is near the center of the county.

Archer County is dissected in a northeast-southwest direction by three major land resource areas: the Central Rolling Red Plains in the northwestern part of the county, the Central Rolling Red Prairies in the central part, and the Texas North Central Prairies in the southeast corner *(4)*.

Physiographically, the area is an old peneplain that has been altered by uplifts and later dissected by creeks and streams. The interstream areas are mostly on gently sloping uplands. A few low escarpments are in scattered areas throughout the county. They are the result of erosion of the alternating clay beds around the more resistant sandstone strata.

Archer County is known historically for its geological formations. The surface exposures date back to the Pennsylvanian period (300 million years) in the southeast corner and the Permian period (270 million years) over the remaining part of the county *(1, 7)*. The presence of fossil remains has attracted scientific expeditions that have found vertebrae of ancient amphibians and evidence of reptiles, mastodons, and giant insects. Fossil remains found in Archer County are displayed in the Smithsonian Institute and other museums around the world *(6)*.

The land surface is nearly level to undulating and hilly with a few escarpments. The elevation ranges from about 950 feet above sea level to about 1,350 feet above sea level with a general dip to the northeast. The county has drainage to three major river basins. A small portion of the southwest corner drains to the Brazos River, the southeast corner drains to the West Fork of the Trinity River, and the remainder of the county drains to the Red River by way of the Wichita River basin.

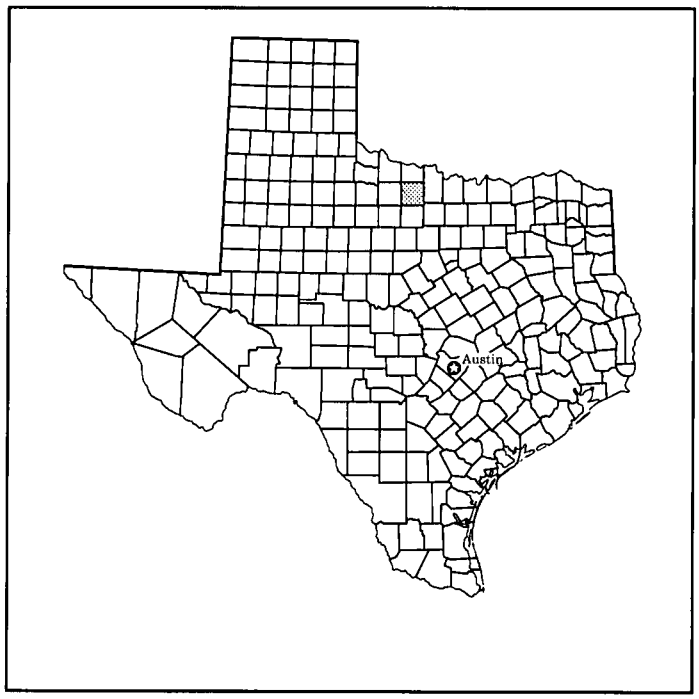

Figure 1.—Location of Archer County in Texas.

This soil survey updates the survey of Archer County

published in 1914 *(8)*. It provides additional interpretive information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section gives information about the county. It describes settlement and population, natural resources, agriculture, and climate.

Settlement and Population

Archer County was part of the Peter's Colony Grant of 1841. It was established in 1858 from Fannin County and was organized on July 27, 1880. The county was named for Dr. Branch T. Archer, who fought for Texas independence and was Texas Commissioner to the United States and Secretary of War under Republic of Texas President Mirabeau B. Lamar *(5)*.

In 1980, the population of Archer County was 7,266 *(5)*. Archer City, the county seat, had a population of 1,862.

Other incorporated towns in the county are Holliday, Lakeside City, Megargel, Scotland, and Windthorst. Dundee and Mankins are unincorporated settlements.

Natural Resources

Soil is one of the most important natural resources in the county. The production of livestock and livestock products, feed grain, and forage is a major source of livelihood.

Oil and gas, which are produced from numerous wells in the county, provide an additional source of income to some landowners. Many people are employed by the companies that drill and service oil and gas wells.

Five large constructed lakes are located wholly or partially in Archer County. They supply critically needed water to municipal areas in Archer, Clay, Young, and Wichita Counties. They also are a major source of recreation.

Agriculture

Milk production is the main agricultural enterprise in Archer County. It accounted for about 50 percent of the total agricultural income in 1984. Beef cattle production, which ranks second, brought in about 31 percent of the agricultural income, and the production of small grain, which ranks third, brought in 7 percent. Other agricultural income was derived from the sale of swine, poultry, eggs, sheep, hay, cotton, wool, and horses and from hunting leases.

Livestock enterprises are primarily cow-calf operations. Supplemental feeding of range cattle is generally needed from December through the early part of March. Approximately 82 percent of the total land area of the county is rangeland.

About 16 percent of the total land area of the county is used for nonirrigated crops. Cool-season small grain is the main crop. Small acreages are planted to forage sorghum and cotton. Cultivated crops are used for cash income or as supplemental feed for livestock.

The acreage of agricultural land in the county is slowly decreasing as more land is used for urban, commercial, or recreational development; as sites for livestock feeding operations; and as sites for farmsteads. In 1985, about 10,790 acres in the county was used for these purposes. Recently constructed lakes have also reduced the amount of land used for agriculture. Some areas of oil wasteland are increasing in size at the expense of agricultural land.

Climate

Archer County is hot in summer and cool in winter when an occasional surge of cold air causes a sharp drop in otherwise mild temperatures. Rainfall is uniformly distributed throughout the year, reaching a slight peak in spring. Snowfall is infrequent. Annual total precipitation is normally adequate for cotton, feed grain, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Archer City, Texas, in the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 44 degrees F and the average daily minimum temperature is 31 degrees. The lowest temperature on record, which occurred at Archer City on January 23, 1966, is -5 degrees. In summer, the average temperature is 83 degrees and the average daily maximum temperature is 95 degrees. The highest recorded temperature, which occurred on June 28, 1980, is 114 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 28 inches. Of this, about 18 inches, or nearly 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10,

the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 7.95 inches at Archer on October 12, 1981. Thunderstorms occur on about 48 days each year.

The average seasonal snowfall is about 4 inches. The greatest snow depth at any one time during the period of record was 3 inches.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 14 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally. These storms are local in extent and of short duration. Their pattern of damage is variable and spotty.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit.

Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Each map unit is rated for *range, cultivated crops, urban uses,* and *recreation areas.* Cultivated crops are those grown extensively in the survey area. Urban uses include residential, commercial, and industrial developments. Recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic.

1. Bluegrove-Jolly-Weswind

Gently sloping to strongly sloping, very deep, moderately deep, and shallow, loamy soils; on uplands

This unit is on broad, sandstone-capped ridges and divides that are characterized by low relief and that alternate with narrow, shallow valleys and a few broad, flat outwash plains. Narrow bands of Rock outcrop and a few steep escarpments commonly separate the ridges and the valleys. Slopes range from 1 to 5 percent on the crest of ridges and divides and on valley floors. Side slopes have gradients of 2 to 12 percent. The narrow valleys make up areas of concentrated water flow. These valleys join to form small creeks that flow in winding courses throughout narrow flood plains.

This unit makes up about 27 percent of the county. It is about 25 percent Bluegrove soils, 15 percent Jolly soils, 10 percent Weswind soils, and 50 percent other soils, Rock outcrop, and Oil-waste land (fig. 2).

The moderately deep, moderately slowly permeable Bluegrove soils are on the gently sloping, convex summit of ridges and divides and on side slopes. Typically, the surface layer is brown fine sandy loam about 8 inches thick. The upper 12 inches of the subsoil is reddish brown clay, and the lower 9 inches is reddish brown clay loam layered with thin, discontinuous strata of soft sandstone bedrock. The underlying material is pale yellow, weakly cemented sandstone bedrock that increases in hardness with increasing depth.

The shallow, moderately permeable Jolly soils are on gently sloping to strongly sloping, convex shoulder slopes. Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is reddish brown. The upper 6 inches is sandy clay loam, and the lower 7 inches is sandy clay loam interlayered with thin strata of discontinuous, soft sandstone bedrock. The underlying material is pale yellow, weakly cemented sandstone bedrock that increases in hardness with increasing depth. Sandstone rock outcrops occur as flush surface exposures or as stones and boulders that protrude through or lie on the surface and form narrow rock outcrop contours in about 40 percent of these areas.

The very deep, moderately slowly permeable Weswind soils are on gently sloping, convex side slopes and foot slopes. Typically, the surface layer is brown fine sandy loam about 5 inches thick. The upper 7 inches of the subsoil is reddish brown clay loam, the next 10 inches is reddish brown clay, and the lower 26 inches is clay mottled in shades of brown and red. The underlying material is clay mottled in shades of red, brown, and gray. It includes fragments of gray shale. Accumulations of calcium carbonate range from about 20 percent soft masses and hard concretions between depths of 48 and 65 inches to only a few below a depth of 65 inches.

Of minor extent in this unit are Deandale, Kamay, Tillman, and Wichita soils on nearly level ridge crests and on concave toe slopes and valley floors; Aspermont, Latom, and Vernon soils on shoulder slopes between ridges and valleys; Grandfield and Winters

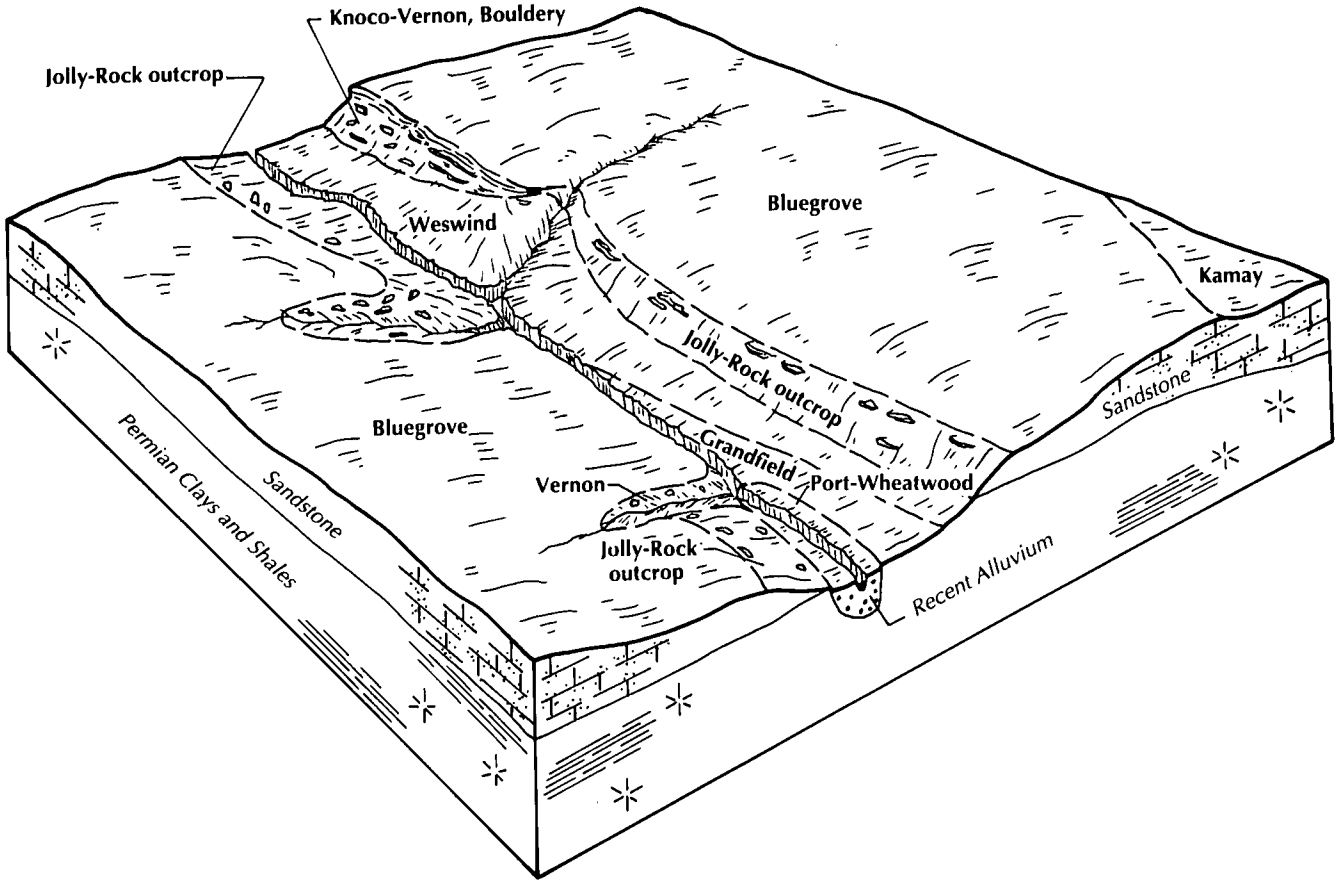

Figure 2.—Typical pattern of soils and parent material in the Bluegrove-Jolly-Weswind general soil map unit.

soils on low terraces adjacent to stream channels; Knoco and Vernon soils and sandstone boulders on steep escarpments; and Mangum, Port, Wheatwood, and Yomont soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 94 percent of this unit is rangeland. About 4 percent is used as cropland or, in a few small areas, is seeded to pasture grasses. About 2 percent is used for nonagricultural purposes. The climax native plant community is mid prairie grasses and a few scattered forbs and low-growing shrubs. This natural vegetation provides ample forage for livestock in most years. Droughtiness reduces yields in some years. Mesquite has invaded many areas. Brush control, proper stocking rates, and a planned grazing system help to improve the quality and increase the quantity of desirable forage. The improved vegetative cover helps to control soil loss and water loss, especially on the steeper slopes.

The native range vegetation on these soils provides good habitat for game birds, songbirds, and small furbearers. Scattered areas of mesquite provide good nesting and resting cover for small birds. Narrow flood plains provide travel lanes and escape cover for coyote, turkey, and deer.

The Bluegrove and Weswind soils can be used for cultivated crops. They are best suited to cool-season small grain and warm-season crops that produce large amounts of residue. The droughtiness is a problem in some years, especially during the summer. Returning crop residue to the surface, terracing, farming on the contour, and applying minimum tillage in a timely manner help to control wind erosion and water erosion. Crop residue management improves soil productivity and tilth. Timely application of fertilizer according to soil tests increases crop yields in most years. Jolly soils are not suited to cultivated crops because of the depth to bedrock and the sandstone fragments on the surface.

The depth to bedrock on the summit of ridges and on shoulder slopes and the stones and boulders on the surface of shoulder slopes are limitations affecting urban and recreational uses. Proper design and careful

installation minimize the effects of most soil restrictions. Many areas adjacent to and overlooking flood plains are especially desirable homesites.

2. Kamay-Deandale

Nearly level and gently sloping, very deep, loamy soils; on terraces and uplands

This unit is on broad plains that are characterized by low relief and that are dissected in some areas by narrow flood plains and interspersed with low, sandstone-capped hills and narrow ridges. Slopes range from 0 to 3 percent. The narrow flood plains eventually merge in a typical dendritic pattern forming larger flood plains that are dissected by winding creek channels.

This unit makes up about 14 percent of the county. It is about 50 percent Kamay soils, 15 percent Deandale soils, and 35 percent other soils and Oil-waste land (fig. 3).

The slowly permeable Kamay soils are on broad, level plains and on broad or narrow convex divides. Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil to a depth of 80 inches is reddish brown clay. It is calcareous below a depth of 11 inches. The underlying material is dark reddish brown clay interlayered with light greenish gray shale.

The very slowly permeable Deandale soils are on broad, level plains and in small depressional areas. Typically, the surface layer is pale brown silt loam about 8 inches thick. The subsoil is clay about 72 inches thick. It is dark grayish brown to a depth of 17 inches, dark brown to depth of 22 inches, brown to a depth of 44 inches, and light reddish brown to a depth of 80 inches. Accumulations of calcium carbonate are below a depth of 17 inches.

Of minor extent in this unit are Hollister, Tillman, and Wichita soils on nearly level plains and gently sloping side slopes; Bluegrove, Jolly, and Latom soils and narrow bands of Rock outcrop on sandstone-capped, low hills and ridges; Aspermont, Knoco, and Vernon soils on eroded, low hills and the steeper side slopes

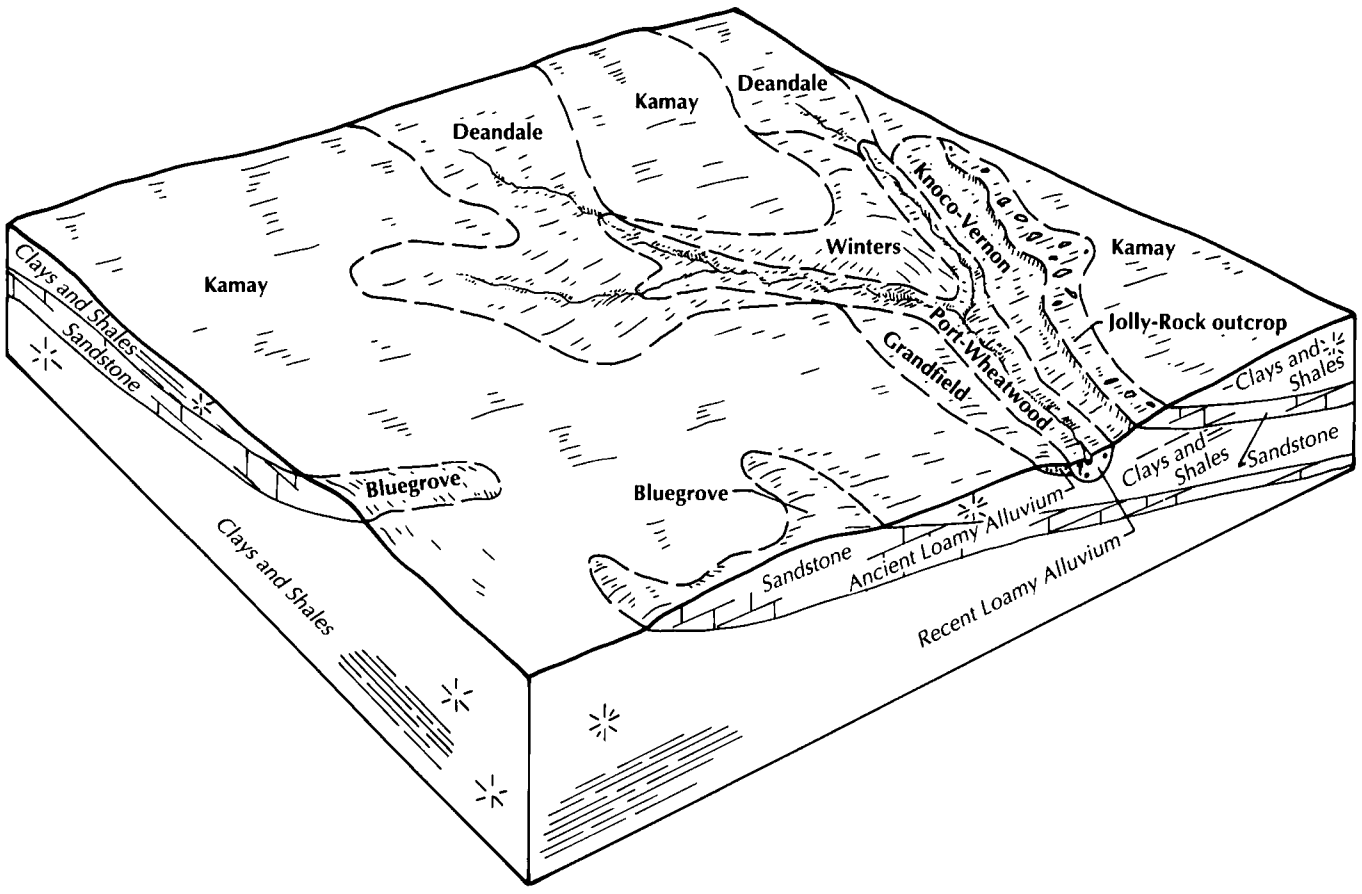

Figure 3.—Typical pattern of soils and parent material in the Kamay-Deandale general soil map unit.

adjacent to flood plains; Grandfield, Weswind, and Winters soils on side slopes adjacent to flood plains and on low terraces; and Mangum, Port, and Wheatwood soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 67 percent of this unit is rangeland. About 31 percent is used as cropland or, in a few small areas, is seeded to pasture grasses. About 2 percent is used for nonagricultural purposes. The climax native plant community is short and mid prairie grasses. This natural vegetation provides adequate but not abundant forage in most years. Forage production is limited because these soils tend to be droughty. The restricted movement of air and water in the subsoil and the retarded growth of roots also are limitations.

The natural vegetation on these soils provides ample habitat for game birds, songbirds, and small furbearers. The droughtiness limits production of seed-bearing plants and thus also limits food supplies. Areas of mesquite provide good nesting and resting cover for birds. The narrow flood plains provide travel lanes and escape cover for coyote, deer, and turkey.

This unit is suited to cool-season small grain and warm-season crops. A lack of adequate rainfall limits yields of warm-season crops in most years. Leaving crop residue on the surface, applying minimum tillage in a timely manner, terracing, using proper crop rotations, and farming on the contour help to conserve moisture and prevent excessive erosion. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases crop yields in most years.

The high content of clay, a high shrink-swell potential, corrosivity to uncoated steel, and slow permeability are limitations on sites for urban development. The slope and the hazard of erosion limit some recreational uses. Proper design and careful installation minimize the effects of most soil restrictions.

3. Vernon-Knoco

Undulating to steep, very deep, shallow, and very shallow, clayey soils; on uplands

This unit is on elongated side slopes and in gently rolling headcut areas that are characterized by low relief. Most of these areas are on breaks or in transitional areas from uplands to bottom land or drainageways. Short, steep escarpments are mainly at the point of contact of the unit with the deeper upland soils. Narrow, sandstone-capped ridges and divides of pronounced relief commonly separate small watersheds. Geologic erosion is active with numerous small drainageways and gullies dissecting the unit. Sandstone flagstones and boulders are common on escarpments below sandstone-capped ridges. Slopes range from 2 to 12 percent in rolling headcut areas and on the smoother side slopes and from 10 to 45 percent on escarpments.

This unit makes up about 13 percent of the county. It is about 40 percent Vernon soils, 20 percent Knoco soils, and 40 percent other soils, Rock outcrop, Badland, and Oil-waste land (fig. 4).

The Vernon soils are very deep, weakly developed, and very slowly permeable. Typically, the surface layer is dark brown, calcareous clay about 4 inches thick. The subsoil to a depth of 23 inches is reddish brown, calcareous clay with common concretions of calcium carbonate. The upper 4 inches of the underlying material is reddish gray, calcareous clay. The lower part is shaly clay mottled in shades of yellow and gray.

The Knoco soils are shallow and very shallow and are very slowly permeable. Typically, the surface layer is reddish brown, calcareous gravelly clay about 3 inches thick. Below this to a depth of 9 inches is a transitional layer of reddish brown, calcareous clay that is mottled in shades of red, brown, and gray. The underlying material is dusky red, calcareous very shaly clay mottled in shades of gray and brown. Gravel-sized concretions and a few sandstone flagstones cover 10 to 40 percent of the surface.

Of minor extent in this unit are Aspermont, Kamay, and Wichita soils on the nearly level to gently sloping crest of low hills; Bluegrove, Jolly, and Latom soils and Rock outcrop on the crest of sandstone-capped ridges; Mangum, Port, and Wheatwood soils on narrow flood plains; and Badland on steep escarpments and on toe slopes. Oil-waste land is in small areas throughout the unit.

This unit is used as rangeland. It is not suited to cropland or pasture. Annual production of short and mid grasses varies depending on depth of the soil and annual rainfall. Because of the high content of clay, very slow permeability, and a lack of adequate rainfall, these soils are very droughty. Surface crusting and scalding become severe if native range vegetation is removed by adverse climatic conditions or is overgrazed. If a crust forms, it impedes emergence of germinating seedlings and accelerates erosion. Poor vegetative growth or an absence of vegetative cover results in poor or inadequate food supplies and shelter for wildlife. A planned grazing system that includes long rest periods improves range condition.

A high shrink-swell potential, the high content of clay, the slope, low load-bearing strength, the very slow permeability, a high content of salt, corrosivity to uncoated steel, a high erosion potential, and the droughtiness are severe limitations affecting urban and recreational uses.

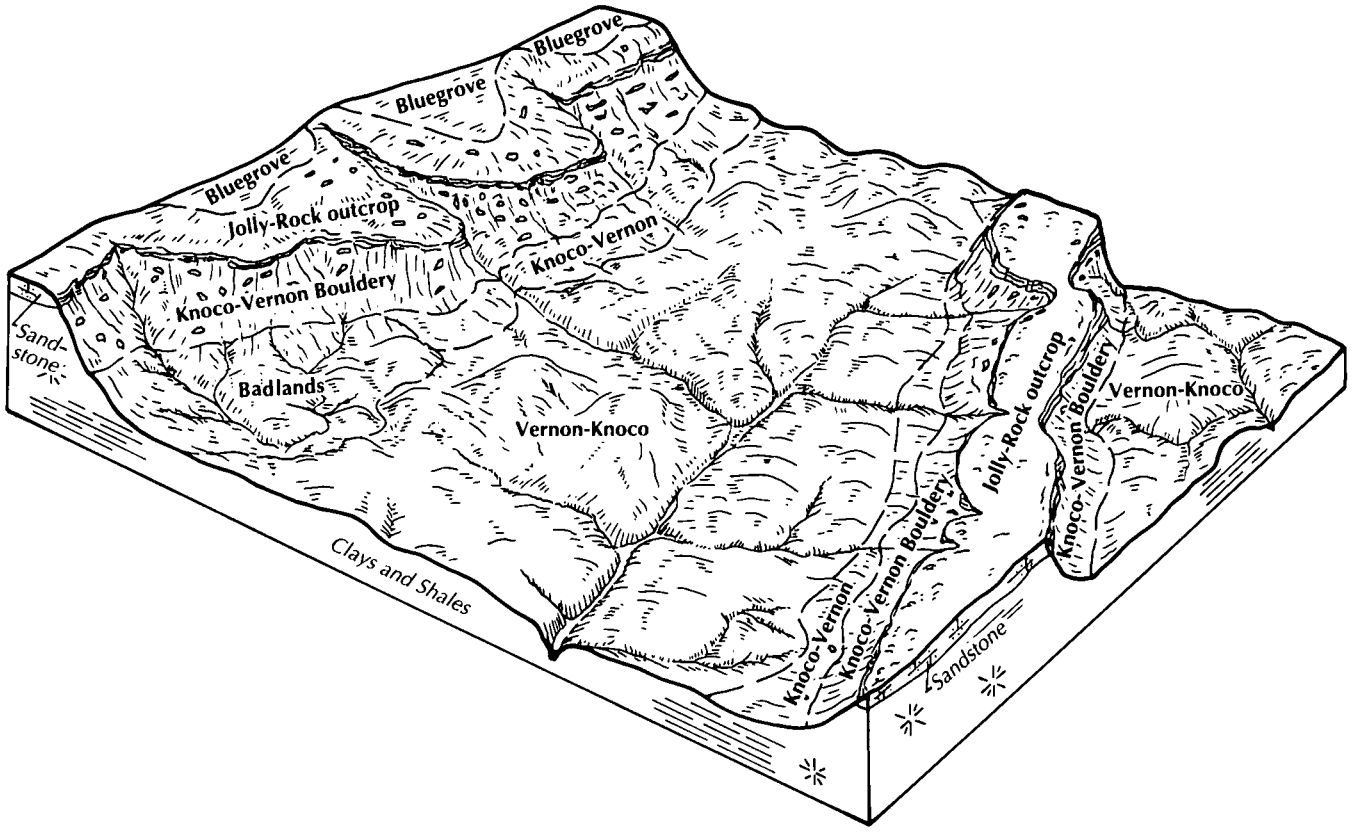

Figure 4.—Typical pattern of soils and parent material in the Vernon-Knoco general soil map unit.

4. Tillman-Vernon

Nearly level and gently sloping, very deep, loamy and clayey soils; on uplands

This map unit is on broad, nearly level plains dissected in some areas by narrow, meandering flood plains and interspersed with isolated, narrow ridges and knolls that are characterized by low relief. Some of the ridges and knolls are capped by sandstone bedrock. Slopes range from 0 to 3 percent on the plains and from 1 to 8 percent on the knolls and ridges. The narrow flood plains merge downstream and form broader flood plains that are dissected by winding creek channels.

This map unit makes up about 13 percent of the county. It is about 55 percent Tillman soils, 10 percent Vernon soils, and 35 percent other soils and Oil-waste land (fig. 5).

The slowly permeable Tillman soils are on nearly level to gently sloping plains. Typically, the surface layer is dark brown clay loam about 6 inches thick. The upper 9 inches of the subsoil is dark brown clay, the next 44 inches is reddish brown clay, and the lower 14 inches is yellowish red clay. The underlying material is shaly clay mottled in shades of brown, red, and gray. Concretions of calcium carbonate are below a depth of 15 inches. Salt crystals typically are below a depth of 33 inches.

The weakly developed, very slowly permeable Vernon soils are on knolls, ridges, and eroded side slopes. Typically, the surface layer is dark brown clay about 4 inches thick. The upper 19 inches of the subsoil is reddish brown clay, and the lower 4 inches is reddish gray clay. The underlying material is mottled grayish and yellowish shaly clay. These soils are calcareous throughout with common soft masses and concretions of calcium carbonate in the surface layer and subsoil.

Of minor extent in this unit are Aspermont soils on ridges, knolls, and the steeper side slopes; Bluegrove, Jolly, and Latom soils and Rock outcrop on sandstone-capped ridges and knolls; Deandale, Hollister, Rotan, and Wichita soils in flat or depressional areas; Hollister, Kamay, Weswind, and Winters soils on gently sloping side slopes and terraces; Grandfield and Winters soils on side slopes adjacent to flood plains; Knoco soils on eroded interfluves; and Mangum, Port, and Wheatwood

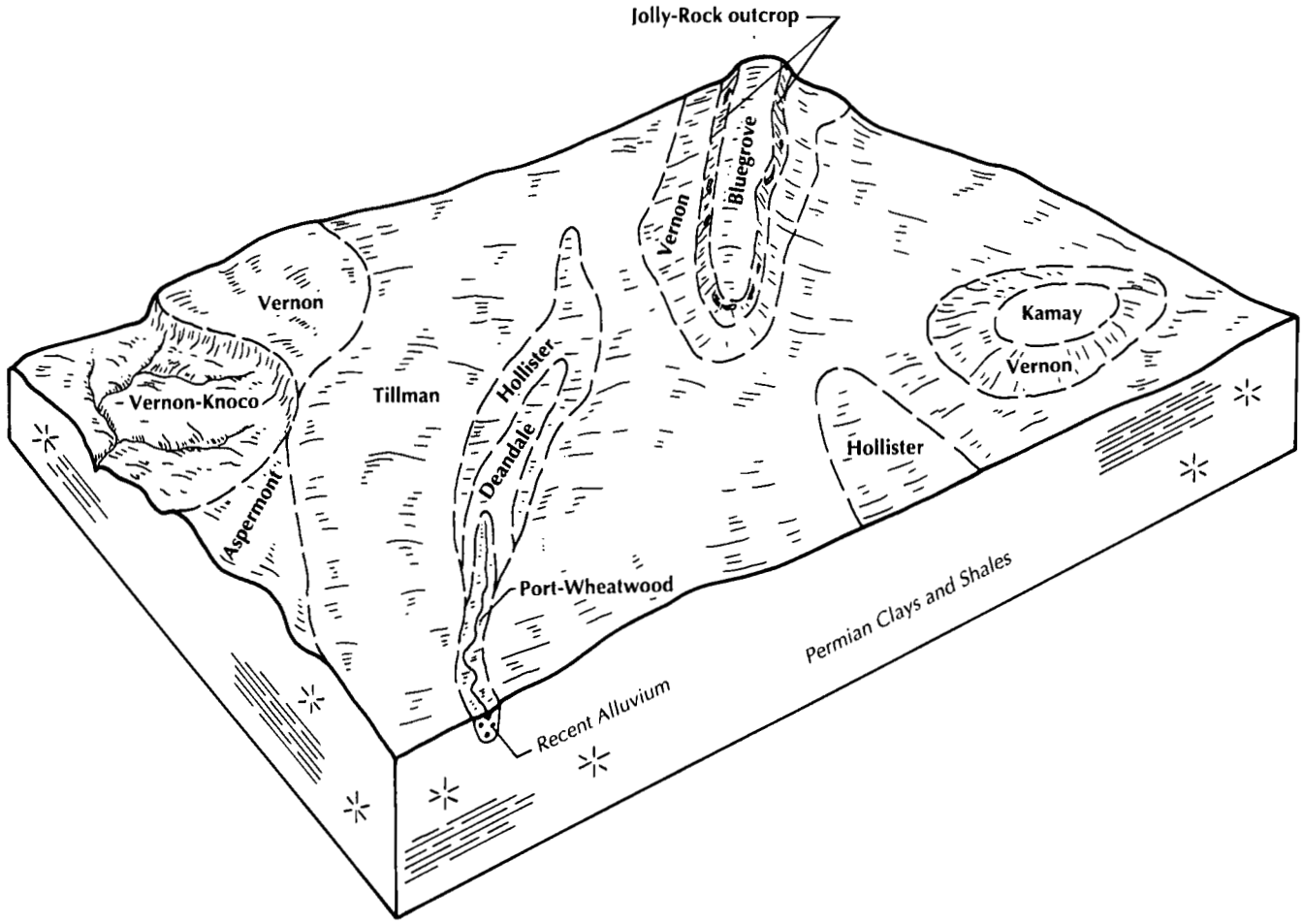

Figure 5.—Typical pattern of soils and parent material in the Tillman-Vernon general soil map unit.

soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 78 percent of this unit is rangeland. About 20 percent is used as cropland or, in a few small areas, is seeded to pasture grasses. About 2 percent is used for nonagricultural purposes. The climax native plant community is short and mid prairie grasses. The natural vegetation growing on the Tillman soils provides ample forage in most years. Droughtiness of the Vernon soils results in a sparse cover of natural vegetation and less abundant forage. Because of the high content of clay in the subsoil of both soils, slow permeability, and sporadic rainfall, the Tillman and Vernon soils are droughty in some years. Mesquite has invaded the unit. Brush control and a controlled grazing system improve the condition of the range.

The natural vegetation on these soils provides good habitat for game birds, songbirds, and small furbearers. The production of seed-producing plants is limited during periods of drought. Areas of mesquite provide good nesting and resting cover for birds. The narrow flood plains provide travel lanes for coyote, turkey, and deer.

This unit is best suited to cool-season small grain. A lack of adequate rainfall limits yields of warm-season crops in some years. Leaving crop residue on the surface, applying minimum tillage in a timely manner, terracing, using proper crop rotations, and farming on the contour help to conserve moisture and control erosion. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer according to soil tests increases crop yields in most years.

The high content of clay, the slow permeability, low load-bearing strength, a high shrink-swell potential, and corrosivity to uncoated steel are limitations affecting

urban development and some recreational uses. Proper design and careful installation help to overcome these limitations.

5. Winters-Deandale

Nearly level and gently sloping, very deep, loamy soils; on terraces and outwash plains

This unit is on broad outwash plains that are dissected by small stream channels and narrow flood plains. The areas between the flood plains are generally flat with gentle slopes parallel to and grading to creeks and flood plains. Slopes range from 0 to 3 percent.

This unit makes up about 11 percent of the county. It is about 40 percent Winters soils, 35 percent Deandale soils, and 25 percent other soils and Oil-waste land.

The moderately slowly permeable Winters soils are on broad, smooth plains and gently sloping side slopes and on very low ridges. Typically, the surface layer is brown loam about 11 inches thick. The upper 10 inches of the subsoil is reddish brown clay, the next 9 inches is yellowish red clay, and the lower 38 inches is yellowish red clay loam. The underlying material is stratified yellowish red and reddish yellow sandy clay loam. Accumulations of calcium carbonate are below a depth of 30 inches.

The very slowly permeable Deandale soils are on broad, smooth plains and in small depressional areas. Typically, the surface layer is pale brown silt loam about 8 inches thick. The subsoil is clay throughout. The upper 9 inches is dark grayish brown, the next 5 inches is dark brown, the next 22 inches is brown, and the lower 36 inches is light reddish brown. Accumulations of calcium carbonate are below a depth of 17 inches.

Of minor extent in this unit are Bluegrove soils on sandstone-capped ridges that are characterized by low relief; Grandfield and Weswind soils on side slopes adjacent to flood plains and terraces of large flood plains; Hollister soils in depressions; Kamay, Tillman, and Wichita soils on convex, low ridges and level plains; and Mangum, Port, and Wheatwood soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 58 percent of this unit is rangeland. About 40 percent is cropland, and 2 percent is used for nonagricultural purposes. The climax native plant community is short and mid prairie grasses and a few scattered forbs and low-growing shrubs, especially in areas of the Winters soils. Water and air move slowly through the Deandale soils, which tend to be droughty in most years. Mesquite has invaded some areas. The Winters and Deandale soils respond favorably to brush control and reseeding. The extent of desirable forage can be increased by applying a controlled grazing system and proper stocking rates.

The natural vegetation on these soils provides ample food and cover for small wildlife. The flood plains provide travel lanes and protective cover for the larger species. Scattered areas of mesquite provide nesting and resting cover for birds.

Small grain is the main crop grown on these soils. A small acreage is planted to cotton and forage sorghum. The droughtiness is a limitation for warm-season crops in some years during the summer. Moderate levels of sodium in the subsoil of some of the Deandale soils reduce yields. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface help to conserve moisture and maintain productivity and tilth. Contour farming and terracing help to control erosion in the more sloping areas. Timely application of fertilizer according to soil tests increases crop yields in most years.

Slow permeability, the high content of clay, a moderate or high shrink-swell potential, the excess sodium in the subsoil of some of the Deandale soils, and corrosivity to uncoated steel can hinder development of both soils for most urban and some recreational uses. Proper design and careful installation minimize the effects of most soil restrictions.

6. Bluegrove-Kamay

Nearly level and gently sloping, moderately deep and very deep, loamy soils; on uplands

This map unit is on broad, sandstone-capped ridges and divides and a few isolated knolls, all of which have low relief, separated by broad outwash plains and a few narrow valleys. Slopes typically range from 0 to 3 percent. Some side slopes have gradients of as much as 5 percent. The outwash plains are dissected by narrow flood plains, which are dissected by meandering creek channels.

This unit makes up about 9 percent of the county. It is about 35 percent Bluegrove soils, 15 percent Kamay soils, and 50 percent other soils, Rock outcrop, and Oil-waste land.

The moderately deep, moderately slowly permeable Bluegrove soils are on sandstone-capped ridges, divides, and knolls. Typically, the surface layer is brown fine sandy loam about 8 inches thick. The upper 12 inches of the subsoil is reddish brown clay, and the lower 9 inches is reddish brown clay loam stratified with thin, discontinuous layers of soft sandstone bedrock. The underlying material is pale yellow, weakly cemented sandstone bedrock that increases in hardness with increasing depth.

The very deep, slowly permeable Kamay soils are on the sides of ridges and divides and on outwash plains.

Figure 6.—A typical landscape in the Bluegrove-Kamay general soil map unit.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil to a depth of 80 inches is reddish brown clay. It is calcareous below a depth of 11 inches. The underlying material is reddish brown clay interlayered with light greenish gray shale.

Of minor extent in this unit are Aspermont, Knoco, and Vernon soils on back slopes below areas of Rock outcrop and on low hills and knolls; Deandale, Hollister, Tillman, and Wichita soils on nearly level to gently sloping outwash plains and on the crest of broad divides that are not underlain by sandstone bedrock; Jolly and Latom soils and Rock outcrop on the crest of very narrow ridges and on the shoulder slopes of sandstone-capped ridges and divides; Grandfield, Weswind, and Winters soils on foot slopes and terraces adjacent to flood plains; and Mangum, Port, and Wheatwood soils on flood plains. Oil-waste land is in scattered areas throughout the unit.

About 93 percent of this unit is rangeland (fig. 6). About 5 percent is used as cropland or, in a few small areas, is seeded to pasture. About 2 percent is used for nonagricultural purposes. The climax range vegetation is short and mid prairie grasses and a few scattered forbs and low-growing shrubs. This natural vegetation provides ample forage under good management. Droughtiness reduces yields in some years, especially in areas of the Kamay soils. Mesquite has invaded many areas of the unit. Brush control, proper stocking rates, and a planned grazing system help to improve the quality and increase the quantity of desirable forage. The improved vegetative cover helps to control soil loss and water loss, especially on the steeper slopes.

The native vegetation provides good habitat for game birds, songbirds, and small furbearers. Scattered areas of mesquite provide good nesting and resting cover for birds. Narrow flood plains provide travel lanes and escape cover for coyote, turkey, and deer.

This unit is suited to cool-season small grain and warm-season crops. A lack of adequate rainfall limits yields of warm-season crops in most years. Leaving crop residue on the surface, applying minimum tillage in a timely manner, terracing, farming on the contour, and using proper crop rotations help to conserve moisture and prevent excessive erosion. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases crop yields in most years.

The depth to bedrock on the summit of sandstone-capped ridges, stones and boulders on shoulder slopes of these ridges, the high content of clay, a high shrink-swell potential, corrosivity to uncoated steel, and slow permeability are limitations on sites for urban development. The slope and a potential for erosion limit some recreational uses. Proper design and careful installation minimize the effects of most soil restrictions.

7. Windthorst-Bonti-Darnell

Gently sloping to rolling, very deep, moderately deep, and shallow, loamy soils; on uplands

This map unit is on low, sandstone-capped hills and ridges that are separated by narrow, branching creeks and draws and a few broad outwash plains and flood plains. Narrow bands of sandstone rock outcrops and a few steep escarpments commonly separate ridge crests and side slopes. Slopes range from 1 to 5 percent on ridge crests, foot slopes, and outwash plains and from 2 to 15 percent on shoulder slopes and back slopes.

This unit makes up about 5 percent of the county. It is about 25 percent Windthorst soils, 20 percent Bonti soils, 10 percent Darnell soils, and 45 percent other soils, Rock outcrop, and Oil-waste land.

The very deep, moderately slowly permeable Windthorst soils are on side slopes and in draws and valleys. Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is clay loam in the upper 4 inches, sandy clay in the next 20 inches, and sandy clay loam in the lower 7 inches. It is reddish brown in the upper part and mottled in shades of brown and red in the lower part. The underlying material is mottled in shades of brown, yellow, red, and gray. It dominantly is sandy clay to a depth of 80 inches. It is interlayered with loamy and shaly material in the lower part.

The moderately deep, moderately slowly permeable Bonti soils are on the crest of hills and ridges and on shoulder slopes. Typically, the surface layer is brown fine sandy loam 7 inches thick. The subsoil to a depth of 35 inches is sandy clay. It is reddish brown in the upper part and reddish brown and mottled in shades of red in the lower part. The underlying material is yellowish red, strongly cemented sandstone bedrock.

The shallow, moderately rapidly permeable Darnell soils are on the crest of hills and ridges and on shoulder slopes. Typically, the surface layer is brown fine sandy loam about 4 inches thick. The subsoil extends to a depth of 11 inches. It is light yellowish brown gravelly fine sandy loam. It contains 20 percent soft sandstone fragments. The underlying material is stratified brownish and yellowish, weakly cemented sandstone bedrock that increases in hardness with increasing depth. Sandstone fragments averaging 2 feet across typically cover about 10 percent of the surface.

Of minor extent in this unit are Deandale soils on smooth outwash plains; Grandfield and Winters soils on foot slopes adjacent to flood plains; Exray soils that are mapped in a complex with Darnell soils; Vernon and Knoco soils and sandstone boulders on steep, eroded escarpments and in eroded headcut areas; and Mangum, Port, Westfork, and Wheatwood soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 85 percent of this unit is rangeland. About 13 percent is used as cropland, and 2 percent is used for nonagricultural purposes. The natural climax range vegetation consists of a post oak savanna that has a mid and tall grass understory. Runoff from areas of exposed rock supplements rainfall in areas of the Darnell soils and increases yield potential. The soils on north-facing slopes have greater potential for plant growth than the soils on other slopes since the north-facing slopes receive less direct sunlight. Brush control in nonstony areas, proper stocking rates, and a planned grazing system help to improve the quality and increase the quantity of desirable forage. The improved vegetative cover helps to control soil loss and water loss, especially on the steeper slopes.

Native grasses, scattered seed-producing forbs, and low-growing shrubs provide adequate feed, browse, and cover for both small and large wildlife species. Low availability of vegetation for winter grazing limits deer production. Habitat quality can be improved through planned brush control in patterns and by selection of suitable plants.

Darnell soils are not suited to cultivated crops because of the depth to bedrock and the stones and boulders on the surface. Cool-season small grain and forage sorghum are the main crops grown on the Bonti and Windthorst soils. Droughtiness is a problem some years, especially during the summer. Returning crop residue to the surface, terracing, and farming on the contour help to control erosion, conserve moisture, and maintain soil productivity and tilth. Timely application of fertilizer increases crop yields in most years.

The depth to bedrock, the slope, the large stones on the surface, the high content of clay, low load-bearing strength, shrink-swell potential, and seepage are severe limitations affecting most urban and many recreational uses. Proper design and careful installation minimize the effects of these limitations. Many areas adjacent to and overlooking flood plains are especially desirable homesites.

8. Rotan-Tillman

Nearly level and gently sloping, very deep, loamy soils; on outwash plains

This unit is on broad, smooth plains dissected by occasional narrow, meandering flood plains and interspersed with narrow ridges and hills that are characterized by low relief. Some of the ridges and knolls are capped by sandstone bedrock. Slopes range from 0 to 3 percent.

This unit makes up about 4 percent of the county. It is about 50 percent Rotan soils, 15 percent Tillman soils, and 35 percent other soils and Oil-waste land.

The Rotan soils are moderately slowly permeable. Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil to a depth of 90 inches is calcareous clay. It is dark grayish brown in the upper 21 inches, dark brown in the next 18 inches, reddish yellow in the next 28 inches, and yellowish red in the lower 15 inches. Accumulations of calcium carbonate are throughout the subsoil.

The Tillman soils are slowly permeable. Typically, the surface layer is dark brown clay loam about 6 inches thick. The subsoil to a depth of 73 inches is clay. It is dark brown in the upper 9 inches, reddish brown in the next 44 inches, and yellowish red in the lower 14 inches. The underlying material is shaly clay mottled in shades of brown, red, and gray. Concretions of calcium carbonate are below a depth of 15 inches. Salt crystals typically are below a depth of 33 inches.

Of minor extent in this unit are Kamay and Rowden soils on ridges and knolls that are characterized by very low relief; Vernon soils on sloping, eroded shoulder slopes; Bluegrove and Jolly soils and Rock outcrop on sandstone-capped ridges and knolls; Deandale, Hollister, and Wichita soils in flat or depressional areas; Grandfield soils on foot slopes adjacent to flood plains; Knoco soils in severely eroded areas of exposed shaly clay on steep escarpments and in headcut areas; and Mangum, Port, and Wheatwood soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 95 percent of this unit is used as cropland. About 3 percent is rangeland, and about 2 percent is used for nonagricultural purposes. Small grain and cotton are the main crops grown. A lack of adequate rainfall limits yields of warm-season crops in some years. A hard crust tends to form on bare soil after periods of heavy rainfall. It hinders emergence of germinating seedlings, reduces the rate of infiltration, and increases the rate of erosion. Leaving crop residue on the surface, using proper crop rotations, and applying minimum tillage in a timely manner help to maintain soil productivity and tilth and minimize crusting. Contour farming and terracing help to control erosion in the more sloping areas. Timely application of fertilizer according to soil tests increases crop yields in most years.

The natural climax range vegetation on these soils provides a moderate amount of forage for livestock in most years. The high content of clay in the subsoil of both soils, slow permeability, and sporadic rainfall result in droughty conditions in some years, especially during the summer. The native vegetation consists of short and mid grasses and a few scattered forbs and low-growing shrubs. Mesquite has invaded many areas. The soils respond well to brush control and reseeding. Proper stocking rates and adequate deferment of grazing increase forage production and improve the quality of the forage.

The natural vegetation on these soils provides good habitat for game birds, songbirds, and small furbearers. The production of seed-producing grasses and forbs is limited during periods of drought. Areas of mesquite provide good nesting and resting cover for small birds. Thick vegetative growth along narrow flood plains provides travel lanes and escape cover for both small and large wildlife species.

The high content of clay, slow permeability, low load-bearing strength, a high shrink-swell potential, and corrosivity to uncoated steel affect the use of these soils for urban and some recreational uses. Proper design and careful installation minimize the effects of these limitations.

9. Wheatwood-Mangum

Nearly level, very deep, loamy and clayey soils; on flood plains

This map unit is on broad flood plains that are dissected by meandering stream channels, some of which are deeply entrenched. Flooding ranges from once in 15 to 20 years on some flood plains to two or three times each year on the more active flood plains. Slopes are typically less than 1 percent.

This unit makes up about 4 percent of the county. It is about 45 percent Wheatwood soils, 40 percent Mangum soils, and 15 percent other soils and Oil-waste land.

The moderately permeable Wheatwood soils are on slightly convex natural levees adjacent to stream channels. Typically, the surface layer is reddish brown, calcareous silt loam about 6 inches thick. The subsoil to a depth of 34 inches is calcareous silt loam. It is reddish brown in the upper part and yellowish red in the lower part. The underlying material is stratified reddish brown, light reddish brown, and yellowish red, calcareous silty clay loam, silt loam, and very fine sandy loam.

The very slowly permeable Mangum soils are mainly on flood plains along the larger streams. Typically, these soils are calcareous clay throughout. They are brown to a depth of 5 inches, reddish brown between depths of 5 and 41 inches, and brown below a depth of 41 inches. Accumulations of calcium carbonate and a few salt crystals are below a depth of 16 inches.

Of minor extent in this unit are Gracemore, Port, and Yomont soils on flood plains. Oil-waste land is in small, scattered areas throughout the unit.

About 74 percent of this unit is rangeland. About 24 percent is used as cropland, and 2 percent is used for nonagricultural purposes. The potential climax range community consists mainly of mid grasses and scattered forbs and trees. Denser bands of trees and shrubs are adjacent to stream channels. Additional moisture received as runoff from adjacent uplands and stream overflow increases the production potential of these areas. The density of woody vegetation varies with the amount and frequency of additional water received. These soils respond well to brush control and reseeding. Proper stocking rates and a planned grazing system help to improve the quality of desirable forage and increase production.

These soils provide good habitat for birds and small furbearers throughout the county and for turkey and deer along the larger streams. Several of the woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and seed for wildlife species. The bands of trees and shrubs adjacent to stream channels are used as escape cover and travel lanes by deer, turkey, and coyote. Habitat quality can be improved through planned brush control in patterns and by selection of suitable plants.

Cool-season small grain and warm-season crops can be grown in the less frequently flooded areas of this unit. Droughtiness in areas of the Mangum soils reduces yields in most years, especially those of warm-season crops. A hard crust can form on the surface of both soils after periods of heavy rainfall. It hinders emergence of germinating seedlings and reduces the rate of infiltration. Flooding restricts plant growth and germination and can destroy entire crops if it occurs during critical growth stages. Leaving crop residue on the surface, using proper crop rotations, and applying minimum tillage in a timely manner help to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer according to soil tests increases crop yields in some years. Areas that have a high potential for flooding are not suitable as cropland.

These soils are poorly suited to most urban and recreational uses. The hazard of flooding, a high shrink-swell potential, and slow permeability are some of the limitations.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Deandale silt loam, 0 to 1 percent slopes, is a phase of the Deandale series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Knoco-Vernon complex, 2 to 12 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Kamay-Deandale association, saline, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Port and Wheatwood soils, frequently flooded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Oil-waste land is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

AsC3—Aspermont clay loam, 1 to 5 percent slopes, eroded. This gently sloping soil is on convex shoulder slopes and side slopes below broad, flat plains; on convex, low ridges and divides; and on gently undulating interfluves. The side slopes, ridges, and divides are narrow and elongated. The interfluves are irregular or fan shaped. In most areas the surface layer is thinner than it was originally because it has been eroded by water. In a few areas, all of the original

topsoil has been eroded and concretions normally found in the subsoil are exposed on the surface, forming a partial gravel pavement. Small gullies are in about 50 percent of the mapped areas of this unit. These gullies are 2 to 6 feet wide, 1 to 3 feet deep, and 100 to 300 feet apart. Individual areas range from 10 to 180 acres in size.

Typically, the surface layer is reddish brown, calcareous clay loam about 7 inches thick. The subsoil to a depth of 40 inches is reddish brown, calcareous clay loam that has distinct bands of calcium carbonate in the form of soft masses and concretions. The underlying material is reddish brown silty clay loam and partially weathered red-bed clay and shale.

This soil is well drained. Permeability and available water capacity are moderate. Surface runoff is medium or rapid depending on the slope. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Included with this soil in mapping are small areas of Knoco and Vernon soils on strongly sloping shoulder slopes. Also included are severely eroded areas of soils on short, steep escarpments where the underlying red-bed clay and shale is exposed. Inclusions make up less than 10 percent of this map unit.

This map unit is used mostly as rangeland. The climax plant community includes short and mid grasses. The quantity of desirable forage can be increased and the quality improved by proper stocking rates, a controlled grazing system that includes adequate deferment of grazing, and brush control.

Dove, quail, rabbit, and an occasional coyote, skunk, or badger commonly inhabit areas of this map unit. A wide variety of climatically adapted natural vegetation provides food and cover, but growth and yields are limited.

A few small areas of this soil have been seeded to pasture grasses. Suitable plant species include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. Brush and weed control, a controlled grazing system, and timely application of fertilizer improve the quality and increase the quantity of desirable forage.

This soil is best suited to small grain. When the soil is cropped and a continuous cover of vegetation or crop residue is not maintained on the surface, the surface layer can rapidly become eroded by water. Droughty conditions exist in most years, especially during the summer. A crust forms easily after periods of heavy rainfall if the surface is left unprotected. It adversely affects seedling germination and emergence. Practices that help to control erosion and conserve moisture include terracing, farming on the contour, applying minimum tillage in a timely manner, and leaving crop residue on the surface. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years.

Low strength, a moderate shrink-swell potential, and moderate corrosivity to uncoated steel limit the use of this soil for urban development. These limitations can be overcome by proper planning and design.

This map unit is in capability subclass IVe and the Clay Loam range site.

Ba—Badland. This map unit consists of barren areas of exposed red-bed clays and shales on steep escarpments, rolling toe slopes, and gently sloping interfluves (fig. 7). Small included areas of Knoco soils support sparse vegetation of limited value to livestock and wildlife. Areas of Badland are dissected by numerous small watercourses and gullies. The potential for runoff is very high, and geologic erosion is active. Slopes range from 3 to 75 percent.

This map unit is in capability subclass VIIIe. No range site has been assigned.

BeB—Bluegrove fine sandy loam, 1 to 5 percent slopes. This soil is on gently sloping divides, low ridges, and gentle side slopes. Individual areas are elongated or rounded and are convex. They range from 15 to 3,000 acres in size.

Typically, the surface layer is brown fine sandy loam about 8 inches thick. The upper 12 inches of the subsoil is reddish brown clay, and the lower 9 inches is reddish brown clay loam stratified with thin, discontinuous layers of soft sandstone bedrock. The underlying material is pale yellow, weakly cemented sandstone bedrock that increases in hardness with increasing depth.

This soil is well drained. Permeability is moderately slow, and available water capacity is low. Surface runoff is medium or rapid depending on the slope. The hazards of water erosion and wind erosion are moderate.

Included with this soil in mapping are small areas of Jolly soils and areas of rock outcrop on shoulder slopes, areas of Deandale soils on flat summits, and small areas of Oil-waste land. Inclusions make up less than 20 percent of this map unit.

About 95 percent of the acreage of this map unit is rangeland (fig. 8). The remaining acreage is used as cropland, except for a few small areas that have been seeded to pasture or are used for nonagricultural purposes.

The climax plant community is mid prairie grasses and a few forbs and low-growing woody plants. Proper stocking rates, deferred grazing, and brush control improve the quality and increase the quantity of desirable forage.

Figure 7.—An area of Badland, which is poorly suited to grazing because of the sparse vegetation.

Dove, quail, rabbit, and an occasional coyote, badger, or skunk inhabit areas of this map unit. Under native range conditions, the wide variety of grasses, forbs, and woody plants provide a good supply of food and protective nesting and resting cover.

Suitable pasture grasses are sideoats grama, several varieties of yellow bluestem, indiangrass, Johnsongrass, weeping lovegrass, and switchgrass. Brush and weed control, a controlled grazing system, and timely application of fertilizer help to maintain high production levels of good-quality forage.

This soil is suited to cool-season and warm-season crops. Yields are limited in some years because of the low available water capacity and droughtiness, which occurs mostly during the summer. A crust tends to form after periods of heavy rainfall. It makes emergence of germinating seed difficult. Crop residue management minimizes crusting, conserves soil moisture, and helps to control wind erosion and water erosion. It also helps to maintain soil productivity and tilth. In most areas contour farming and terracing are needed to help prevent excessive water erosion. When cuts or excavations exceed a depth of about 20 inches, cutting into the bedrock is a hazard. Stripcropping and field windbreaks help to control wind erosion. Timely application of fertilizer increases yields in most years.

This soil is well suited to most urban and recreational uses. A moderate shrink-swell potential and the depth

Figure 8.—Native range in an area of Bluegrove fine sandy loam, 1 to 5 percent slopes.

to bedrock can be overcome by proper design and careful installation.

This map unit is in capability subclass IIIe and the Tight Sandy Loam range site.

BtC—Bonti fine sandy loam, 1 to 5 percent slopes. This soil is on gently sloping upland divides, low ridges, and side slopes. It is in the southeastern part of the county in areas where post oak vegetation is dominant. Individual areas are elongated or rounded and are convex. They range from 15 to 700 acres in size.

Typically, the surface layer is brown fine sandy loam about 7 inches thick. The subsoil to a depth of 35 inches is sandy clay. It is reddish brown in the upper part and is reddish brown and mottled in shades of red in the lower part. The underlying material is yellowish red, strongly cemented sandstone bedrock.

This soil is well drained. Permeability is moderately slow, and available water capacity is low. Surface runoff is medium or rapid depending on the slope. The hazards of water erosion and wind erosion are moderate.

Included with this soil in mapping are small areas of Darnell and Exray soils, areas of rock outcrop on shoulder slopes, and small areas of Oil-waste land. Inclusions make up less than 10 percent of this map unit.

This map unit can be used for cultivated crops but is used mainly as range. The climax plant community is a mixture of tall and mid grasses, forbs, and post oak trees (fig. 9). The quantity of desirable forage can be increased and the quality improved by proper stocking rates and adequate deferment of grazing. This soil responds well to brush control followed by reseeding with suitable plant species.

Wildlife commonly found in areas of this map unit include dove, quail, squirrel, turkey, deer, and an occasional coyote, skunk, or badger. Several kinds of

woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and seed for songbirds, furbearers, and small game birds. Deer and turkey feed in areas of this map unit but inhabit areas on adjacent stream bottoms, which provide better escape cover. Habitat quality can be improved through planned brush control in patterns and by selection of suitable plants. Grass and forb production is reduced by excessive grazing by wildlife.

Suitable pasture grasses are kleingrass, sideoats grama, and several varieties of yellow bluestem. A controlled grazing system, weed control, and timely application of fertilizer are necessary to achieve optimum production of high-quality forage.

This soil is suited to cool-season small grain and warm-season crops that produce large amounts of residue. Droughtiness is a problem in some years, especially during the summer. Leaving crop residue on the surface when crops are not being grown conserves soil moisture and helps to control wind erosion and water erosion. Crop residue management also helps to maintain soil productivity and tilth. In most areas contour farming and terracing are needed to help prevent excessive water erosion. When cuts or

Figure 9.—Post oak overstory in an area of Bonti fine sandy loam, 1 to 5 percent slopes.

excavations exceed a depth of about 20 inches, cutting into the bedrock is a hazard. Timely application of fertilizer increases yields in most years.

The depth to bedrock, a moderate shrink-swell potential, low load-bearing strength, and the moderately slow permeability are limitations affecting urban and recreational development. Proper design and careful installation minimize the effects of these limitations.

This map unit is in capability subclass IIIe and the Sandy Loam range site.

DaD—Darnell-Exray complex, 2 to 15 percent slopes, stony. These soils are on ridges, divides, knolls, and side slopes. They are in the southeastern part of the county in areas where post oak vegetation is dominant (fig. 9). Slopes range from 2 to 5 percent on ridge crests and from 5 to 15 percent on the side slopes. The ridges, divides, and side slopes are narrow and elongated, and the knolls are rounded. Surfaces are convex. Individual areas range from 25 to about 350 acres in size.

A typical area of this map unit is 45 percent Darnell soil, 30 percent Exray soil, and 25 percent other soils and rock outcrop. Sandstone fragments averaging 2 feet across typically cover about 10 percent of the surface.

The Darnell and Exray soils are throughout this map unit. They occur as areas that are so intermingled that they could not be mapped separately at the selected scale of mapping. Areas of sandstone bedrock outcrop on ridge crests as flush surface exposures 1 to 8 feet in diameter. These outcroppings cover 5 percent of the surface. Stones and boulders protruding from the surface on shoulder slopes range from 2 to 12 feet across and cover 35 percent of the surface (fig. 10). Side slopes below rock outcrop contours are covered with 2 to 20 percent sandstone flagstones and boulders 2 to 12 feet across.

Typically, the surface layer of the Darnell soil is brown fine sandy loam about 4 inches thick. The subsoil to a depth of 11 inches is light yellowish brown gravelly fine sandy loam. It contains 20 percent soft sandstone fragments. The underlying material is stratified brownish and yellowish, weakly cemented sandstone bedrock that increases in hardness with increasing depth.

The Darnell soil is well drained or somewhat excessively drained. Permeability is moderately rapid, and available water capacity is very low. Surface runoff is medium or rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Typically, the surface layer of the Exray soil is brown fine sandy loam about 5 inches thick. The subsoil is yellowish red. It is clay in the upper 7 inches and gravelly clay in the lower 6 inches. The lower part contains 20 percent soft sandstone fragments. The underlying material is yellow, cemented sandstone bedrock that becomes strongly cemented with increasing depth.

The Exray soil is well drained. Permeability is moderately slow, and available water capacity is very low or low. Surface runoff is medium or rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Included in this unit in mapping are small areas of Vernon and Knoco soils and areas of rock outcrop on shoulder slopes. The rock outcrop covers more than 75 percent of the surface when it occurs. Also included are small areas of Bonti and Latom soils, areas of soils that are similar to the Exray soil but are underlain by shale and clay, and small areas of Oil-waste land.

This map unit is used as rangeland. It is not suited to cropland and is poorly suited to pasture.

The climax plant community consists of a post oak savanna that has a mid and tall grass understory. Runoff from areas of exposed rock supplements rainfall and improves yields. North-facing slopes have greater potential for supporting plant growth than south-facing slopes since the north-facing slopes receive less direct sunlight. Brush control in nonstony areas, proper stocking rates, and a planned grazing system improve the quality and increase the quantity of desirable forage. The improved vegetative cover helps to control soil loss and water loss, especially on the steeper side slopes.

This map unit provides good cover for deer, quail, dove, turkey, and squirrel. An occasional skunk, badger, rabbit, or coyote is common in areas of the unit. Native grasses and scattered seed-producing forbs and low-growing shrubs provide adequate food supplies for quail, dove, and turkey and browse for deer. Oak trees supply acorns for squirrel. Low availability of vegetation for winter grazing limits deer production.

Depth to bedrock, the slope, the large stones on the surface, the high content of clay in the subsoil of the Exray soil, low load-bearing strength, seepage, and piping severely limit these soils for most urban and recreational uses. Proper design and careful installation minimize the effects of several of these limitations.

This map unit is in capability subclass VIIs and in the Sandstone Hill range site.

DeA—Deandale loam, 0 to 1 percent slopes. This soil is on narrow divides and ancient stream terraces. Individual areas are irregular in shape and have plane surfaces. They range from 20 to 340 acres in size.

Typically, the surface layer is brown loam about 9 inches thick. The subsoil is clay. It is dark grayish brown in the upper 11 inches, brown in the next 28

Figure 10.—A typical area of Darnell-Exray complex, 2 to 15 percent slopes, stony.

inches, and yellowish red in the lower 32 inches. Accumulations of calcium carbonate are below a depth of 24 inches.

This soil is moderately well drained. Permeability is very slow. The clayey subsoil severely restricts the growth of roots and the movement of water and air. The available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil in mapping are small areas of Kamay and Winters soils in landscape positions similar to those of the Deandale soil. These soils also are on slightly convex, very low ridges. Also included are small areas of Oil-waste land. Inclusions make up less than 20 percent of this map unit.

Approximately 60 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that have been seeded to pasture and a few areas that are used for nonagricultural purposes.

The climax plant community is short and mid prairie grasses. Potential forage production is limited because the clayey subsoil restricts the growth of roots and the movement of water. This soil is droughty because of the restricted movement of water. The quality of desirable forage can be improved and the quantity increased with proper stocking rates, a controlled grazing system, and brush control.

The natural vegetation provides good cover and adequate food supplies for dove, quail, and rabbit, which are common in this map unit, in addition to an occasional coyote, prairie dog, or skunk. Areas of mesquite provide good nesting and resting cover for dove and an assortment of songbirds.

Suitable pasture grasses include indiangrass, sideoats grama, and many of the bluestem species. Brush and weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer help to increase the quantity and improve the quality of seeded grasses.

The droughtiness limits crop yields in most years. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface conserve soil moisture and help to control erosion. Timely application of fertilizer according to soil tests increases yields in most years.

The very slow permeability, the high content of clay in the subsoil, a high shrink-swell potential, and corrosivity to uncoated steel adversely affect most urban and some recreational uses of this soil. Proper design and construction and careful installation minimize the effects of most of these limitations.

This map unit is in capability subclass IIs and the Claypan Prairie range site.

DeB—Deandale loam, 1 to 3 percent slopes. This soil is on low divides and gently sloping side slopes. Individual areas are elongated or irregular in shape and are convex. They range from 15 to 1,200 acres in size.

Typically, the surface layer is brown loam about 8 inches thick. The subsoil is clay. It is brown in the upper 38 inches and yellowish red in the lower 34 inches. Accumulations of calcium carbonate are below a depth of 23 inches.

This soil is moderately well drained. Permeability is very slow. The clayey subsoil severely restricts the growth of roots and the movement of water and air. The available water capacity is high. Surface runoff is medium. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Kamay and Winters soils in landscape positions similar to those of the Deandale soil. Also included are small areas of Oil-waste land. Inclusions make up less than 25 percent of this map unit.

About 80 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for possibly a few small areas seeded to pasture grasses and a few small areas used for nonagricultural purposes.

The climax plant community is short and mid prairie grasses. Potential forage production is limited because the clayey subsoil restricts the growth of roots and the movement of water. This soil is droughty because of the restricted movement of water. The quantity of desirable forage can be increased and the quality improved with proper stocking rates, a controlled grazing system, and brush control.

The natural vegetation provides good cover and adequate food supplies for dove, quail, songbirds, and rabbit, which are common in this map unit, in addition to an occasional coyote or skunk. Areas of mesquite provide good nesting and resting cover for dove, quail, and songbirds. Seed-producing grasses, forbs, and shrubs supply ample food supplies.

Suitable pasture grasses include indiangrass, sideoats grama, and many of the bluestem species. Brush and weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer improve forage quality and production.

The droughtiness limits crop yields in most years. Leaving crop residue on the surface, applying minimum tillage in a timely manner, terracing, using proper crop rotations, and farming on the contour conserve soil moisture and help to prevent excessive erosion. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years.

The very slow permeability, the high content of clay in the subsoil, a high shrink-swell potential, and corrosivity to uncoated steel adversely affect most urban and some recreational uses of this soil. Proper design and construction and careful installation minimize the effects of these limitations.

This map unit is in capability subclass IIIe and the Claypan Prairie range site.

DnA—Deandale silt loam, 0 to 1 percent slopes. This soil is on broad, flat plains. Individual areas are irregular in shape and have plane or slightly concave surfaces. They range from 20 to 1,980 acres in size.

Typically, the surface layer is pale brown silt loam about 8 inches thick. The subsoil is clay. It is dark grayish brown in the upper 9 inches, dark brown in the next 5 inches, brown in the next 22 inches, and light reddish brown in the lower 36 inches. Accumulations of calcium carbonate are below a depth of 17 inches.

This soil is moderately well drained. Permeability is very slow. The clayey subsoil severely restricts the growth of roots and the movement of water and air. The available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil in mapping are areas of Kamay and Winters soils on slightly convex, very low divides; small areas of Hollister soils; and small areas of Oil-waste land. Also included are some areas of soils in which the salinity level is high enough to affect the growth of crops. Inclusions make up less than 10 percent of this map unit.

Approximately 60 percent of the acreage of this map

unit is rangeland. The remaining acreage is used as cropland or pastureland or, in a few small areas, is used for nonagricultural purposes.

The climax plant community includes short and mid grasses. Potential forage production is limited because the clayey subsoil restricts the growth of roots and the movement of water. This soil is droughty because of the restricted movement of water. The quantity of the forage can be increased and the quality improved with proper stocking rates, a controlled grazing system, and brush control.

Wildlife species found in this map unit include dove, quail, prairie dog, rabbit, and an occasional coyote or skunk. A wide variety of natural vegetation is suitable, but the droughtiness limits growth and yields. The natural vegetation provides adequate food supplies and nesting and resting cover.

Small grain is the main crop grown on this soil. Small acreages are planted to cotton or to forage sorghum. The droughtiness limits crop yields in most years. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface conserve soil moisture and maintain productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

Suitable pasture grasses are indiangrass, Johnsongrass, kleingrass, sideoats grama, and several varieties of yellow bluestem. Brush and weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and improve the quality of forage.

The high content of clay, a high shrink-swell potential, corrosivity to concrete and uncoated steel, and the very slow permeability affect most urban and recreational uses of this soil. Proper design and construction and careful installation minimize the effects of these limitations.

This map unit is in capability subclass IIs and the Claypan Prairie range site.

DnB—Deandale silt loam, 1 to 3 percent slopes. This soil is on short side slopes that are mostly adjacent to small, poorly defined watercourses. Individual areas are dominantly narrow and elongated, but they are broad and fan shaped in headcut areas. They range from 15 to 140 acres in size.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is clay. It is brown in the upper 30 inches and light reddish brown in the lower 45 inches. Accumulations of calcium carbonate are below a depth of 14 inches, and yellowish mottles are below a depth of 48 inches.

This soil is moderately well drained. Permeability is very slow. The clayey subsoil severely restricts the growth of roots and the movement of water and air. The available water capacity is high. Surface runoff is medium. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

Included with this soil in mapping are small areas of Kamay and Winters soils on shoulder slopes and low ridge crests. Also included are areas of soils in which the salinity level of the subsoil is high enough to affect the growth of crops. Included soils make up less than 15 percent of this map unit.

Approximately 65 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that are used for nonagricultural purposes.

The climax plant community is short and mid grasses. Potential forage production is limited because the clayey subsoil restricts the growth of roots and the movement of water and air. This soil is droughty because of the restricted movement of water. The quantity of forage can be increased and the quality improved with proper stocking rates, a controlled grazing system, and brush control.

Small grain is the main crop grown on this soil. Small acreages are planted to cotton or to forage sorghum. The droughtiness limits yields in most years. Leaving residue on the surface when crops are not being grown, applying minimum tillage in a timely manner, using proper crop rotations, terracing, and contour farming help to control erosion and conserve soil moisture. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years.

Suitable pasture grasses include indiangrass, Johnsongrass, kleingrass, sideoats grama, and several varieties of yellow bluestem. Brush and weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and quality of desirable forage.

Wildlife species commonly found in this map unit are dove, quail, rabbit, and an occasional coyote or skunk. A wide variety of vegetation is suitable, but the droughtiness limits growth and production. The natural vegetation provides adequate food supplies and resting and nesting cover.

Limitations that must be overcome for successful urban and recreational development include the high content of clay, a high shrink-swell potential, corrosivity to uncoated steel and concrete, and the very slow permeability.

This map unit is in capability subclass IIIe and the Claypan Prairie range site.

DsA—Deandale silt loam, loamy substratum, 0 to 1 percent slopes. This soil is on broad, flat plains.

Individual areas are irregular in shape and have plane or slightly concave surfaces. They range from 15 to 1,200 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The upper 10 inches of the subsoil is grayish brown clay, the next 27 inches is brown clay loam, the next 19 inches is reddish brown clay loam, and the lower 16 inches is yellowish red clay loam. Accumulations of calcium carbonate are below a depth of 18 inches.

This soil is moderately well drained. Permeability is very slow. The clayey subsoil severely restricts the growth of roots and the movement of water and air. The available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil in mapping are small areas of Port and Wheatwood soils on narrow flood plains adjacent to small streams. Also included are small areas of Oil-waste land; Kamay and Winters soils on slightly convex, low divides; and Deandale soils that have a clayey substratum. Inclusions make up less than 20 percent of this map unit.

Approximately 50 percent of the total acreage of this map unit is used as cropland. The remaining acreage is used as rangeland or pastureland, except for a few small areas that are used for nonagricultural purposes.

Small grain is the main crop grown on this soil. Small acreages are planted to cotton or sorghum. Production is limited in most years because the clayey subsoil restricts the growth of roots and the movement of water. This soil is droughty because of the restricted movement of water. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving residue on the surface when crops are not being grown conserve soil moisture and maintain productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

Yields of pasture grasses and quality of the forage produced can be improved by adequate weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer. Suitable species include indiangrass, Johnsongrass, kleingrass, sideoats grama, and several varieties of yellow bluestem.

The climax plant community includes short and mid grasses. Potential forage production is limited because of the droughtiness. A crust tends to form if the surface is left bare. The quantity of forage can be increased and the quality improved with proper stocking rates, a controlled grazing system, and brush control.

Wildlife species found in this map unit are dove, quail, rabbit, and an occasional coyote or skunk. A wide variety of vegetation is suitable, but the droughtiness limits growth and production. The natural vegetation provides adequate food supplies and nesting and resting cover.

Successful urban and recreational development is limited by the high content of clay, a high shrink-swell potential, corrosivity to uncoated steel and concrete, and the very slow permeability. Proper design and careful installation minimize the effects of these limitations.

This map unit is in capability subclass IIs and the Claypan Prairie range site.

Gm—Gracemore fine sandy loam, frequently flooded. This soil is on the flood plain of the Wichita River. Flooding occurs three to five times each year. The depth to an apparent water table ranges from 0.5 foot to more than 6 feet. It varies with the amount of rainfall received. The soil is saline in areas where the water table is at a depth of less than 4 feet. Salinity of the topsoil ranges from low to high. There is only one area of the soil in the county. The area is long and narrow and is 140 acres in size. The surface is plane or slightly convex. Slopes are less than 1 percent.

Typically, the surface layer is reddish yellow fine sandy loam about 5 inches thick. The underlying material is reddish yellow. The upper 7 inches is loamy fine sand, and the lower 68 inches is loamy fine sand stratified with thin layers of coarse and finer materials. The surface varies in texture, ranging from fine sand to clay loam.

This soil is somewhat poorly drained. Permeability is moderately rapid or rapid above the water table. Available water capacity is low. Surface runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Included with this soil in mapping are small areas of Yomont soils on the slightly higher natural levees within the flood plain and areas of soils that are similar to the Gracemore soil but have a sandy clay or clay surface layer. Also included are small areas of soils that are saline and are not vegetated. Inclusions make up less than 20 percent of this map unit.

This map unit is used as rangeland. The climax plant community is mainly tall grasses but includes a wide variety of desirable forbs and browse. Scattered saline areas occur throughout the map unit. Some of these areas do not have a vegetative cover. Control of saltcedar and a controlled grazing system improve the quality and increase the quantity of desirable forage.

This map unit supports adequate desirable seed-producing forbs and grasses that serve as food and cover for dove, quail, turkey, coyote, small furbearers,

and songbirds. Trees and low-growing brush also provide protective cover. Water is readily available in stream channels.

Limited accessibility by farm equipment restricts the use of this soil for pasture. Salt-tolerant pasture grasses should be selected for planting. Good management measures include brush and weed control, a controlled grazing system, and timely application of fertilizer according to soil tests.

This unit is not suitable as cropland or as a site for urban or recreational development. The frequent flooding, the high water table, the sandy texture, the high content of salt, and the hazard of wind erosion are difficult to overcome.

This map unit is in capability subclass Vw and the Sandy Bottomland range site.

GrC—Grandfield fine sandy loam, 1 to 5 percent slopes. This gently sloping soil is on the low secondary terraces of broad flood plains, on banks and side slopes that flank these flood plains, and on toe slopes below steep upland escarpments. Individual areas are narrow and elongated and are convex. They range from 15 to 150 acres in size.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The upper 18 inches of the subsoil is reddish brown sandy clay loam, the next 12 inches is yellowish red sandy clay loam, and the lower 44 inches is yellowish red fine sandy loam. Yellowish brown mottles are common below a depth of 54 inches. Layers of poorly graded siliceous gravel and coarse sand are commonly below a depth of 80 inches or more commonly below a depth of 120 inches.

This soil is well drained. Permeability and available water capacity are moderate. Surface runoff is medium. The hazards of water erosion and wind erosion are moderate.

Included with this soil in mapping are small areas of Vernon soils on eroded side slopes, small gullied areas adjacent to entrenched stream channels, and small areas of Oil-waste land. Inclusions make up less than 5 percent of this map unit.

Most of this map unit is rangeland. The climax plant community is mid prairie grasses and a few forbs and low-growing woody plants. Proper stocking rates, a controlled grazing system, and brush control improve the quality and increase the quantity of forage.

Dove, quail, rabbit, and badger commonly inhabit areas of this map unit. The wide variety of woody plants, forbs, and grasses provides a good supply of food and protective nesting and resting cover. Deer and turkey feed in areas of this map unit but inhabit areas on adjacent, large stream bottoms, which have abundant brush that provides escape cover and travel lanes.

Suitable pasture grasses include indiangrass, Johnsongrass, weeping lovegrass, bermudagrass, switchgrass, and several varieties of yellow bluestem. Weed control, a controlled grazing system, proper stocking rates, and timely application of fertilizer help to maintain productivity.

This soil is suited to cool-season small grain and warm-season crops. The runoff and the limited available water capacity result in droughty conditions, which limit yields. Terracing, contour farming, using proper crop rotations, and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain productivity and tilth. Cultivation should be timely and limited. Application of fertilizer according to soil tests increases yields in most years.

This soil is well suited to both urban and recreational uses. Many areas overlooking large river bottoms are especially desirable homesites.

This map unit is in capability subclass IIIe and the Sandy Loam range site.

HoA—Hollister silty clay loam, 0 to 1 percent slopes. This soil is in broad, flat areas that have plane surfaces and in small depressional areas that have slightly concave surfaces. Individual areas are irregular in shape. They range from 30 to 1,300 acres in size.

Typically, the surface layer is dark brown silty clay loam about 9 inches thick. The subsoil is clay. It is dark brown in the upper 13 inches, brown and calcareous in the next 36 inches, and reddish yellow and calcareous in the lower 22 inches.

This soil is well drained. Permeability is very slow, and available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil in mapping are small areas of Oil-waste land that make up less than 1 percent of this map unit. Also included are small areas of Deandale and Tillman soils, which make up less than 10 percent of the map unit.

Approximately 65 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that have been seeded to pasture.

The climax plant community consists of short and mid prairie grasses. This soil responds well to brush control and reseeding. Proper stocking rates and a controlled grazing system that includes adequate deferment of grazing increase the quantity and improve the quality of desirable forage.

The natural vegetation provides good cover and

adequate food supplies for dove, quail, prairie dog, coyote, rabbit, and skunk. Areas of mesquite provide good nesting and resting cover for dove.

Suitable pasture grasses include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. Brush and weed control, a planned grazing system, and timely application of fertilizer increase yields and improve forage quality in most years.

A lack of rainfall during the growing season and the formation of a crust are limitations for growing crops. A crust tends to form after periods of heavy rainfall if the surface is left bare. It reduces the rate of infiltration and impedes the emergence of germinating seedlings. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface conserve soil moisture and help to control erosion. Crop residue management helps to maintain soil productivity and tilth and prevent crusting. Timely application of fertilizer according to soil tests increases yields in most years.

The very slow permeability, the high content of clay, a high shrink-swell potential, low load-bearing strength, and corrosivity to uncoated steel adversely affect most urban uses of this soil. Proper design and careful installation minimize the effects of most of these limitations.

This map unit is in capability subclass IIc and the Clay Loam range site.

HoB—Hollister silty clay loam, 1 to 3 percent slopes. This soil is on the short side slopes of small depressional areas and narrow, poorly defined watercourses. Individual areas are narrow and elongated and are convex. They range from 15 to 45 acres in size.

Typically, the surface layer is dark brown silty clay loam about 6 inches thick. The subsoil is clay. It is dark brown in the upper 26 inches, reddish brown in the next 21 inches, and yellowish red in the lower 11 inches. It is calcareous below a depth of 22 inches. The underlying material is mottled reddish brown, yellowish red, weak red, and light gray, calcareous clay.

This soil is well drained. Permeability is very slow, and available water capacity is high. Surface runoff is medium. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Deandale and Tillman soils and small areas of Oil-waste land. Inclusions make up less than 10 percent of this map unit.

Approximately 60 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland.

The climax plant community is short and mid prairie grasses. This soil responds well to brush control and reseeding. The quality and quantity of desirable forage can be improved by proper stocking rates and a planned grazing system that includes adequate deferment of grazing.

Dove, quail, small furbearers, and an occasional coyote, skunk, or prairie dog inhabit areas of this map unit. The number of dove and quail increases as the amount of shrubby and woody vegetation increases. This vegetation provides escape and nesting cover. Habitat quality can be improved by brush control and by selection of desirable grass and forb species for range seeding.

The best suited pasture grasses include sideoats grama, Johnsongrass, kleingrass, indiangrass, and most varieties of yellow bluestem. Brush and weed control, a controlled grazing system, and timely application of fertilizer improve yields and forage quality.

When it is cropped, this soil is best suited to cool-season small grain. In most years yields of warm-season crops are limited by drought in the summer. A crust tends to form after periods of heavy rainfall if the surface is left bare. It reduces the rate of infiltration, increases the rates of runoff and erosion, and impedes the emergence of germinating seedlings. Crop residue management, minimum tillage, crop rotations, terraces, and contour farming help to control erosion and conserve soil moisture. Proper crop residue management also helps to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer increases yields in most years.

The very slow permeability, the high content of clay, a high shrink-swell potential, low strength, and corrosivity to uncoated steel adversely affect most urban uses of this soil. Proper design and construction and careful installation minimize the effects of most soil restrictions.

This map unit is in capability subclass IIe and the Clay Loam range site.

JoC—Jolly-Rock outcrop complex, 2 to 12 percent slopes, stony. This map unit is on ridges, divides, knolls, side slopes, and summits of mesas and buttes (fig. 11). Slopes range from 2 to 5 percent on summits and ridge crests, from 5 to 12 percent on shoulder slopes, and from 2 to 8 percent on the lower side slopes and toe slopes. The ridges, divides, and side slopes are narrow and elongated, and the knolls and summits of mesas and buttes are rounded. Surfaces are convex. Erosion has thinned the topsoil on many ridgetops and summits. In places the topsoil has been eroded away, exposing the subsoil. Small gullies 2 to 4

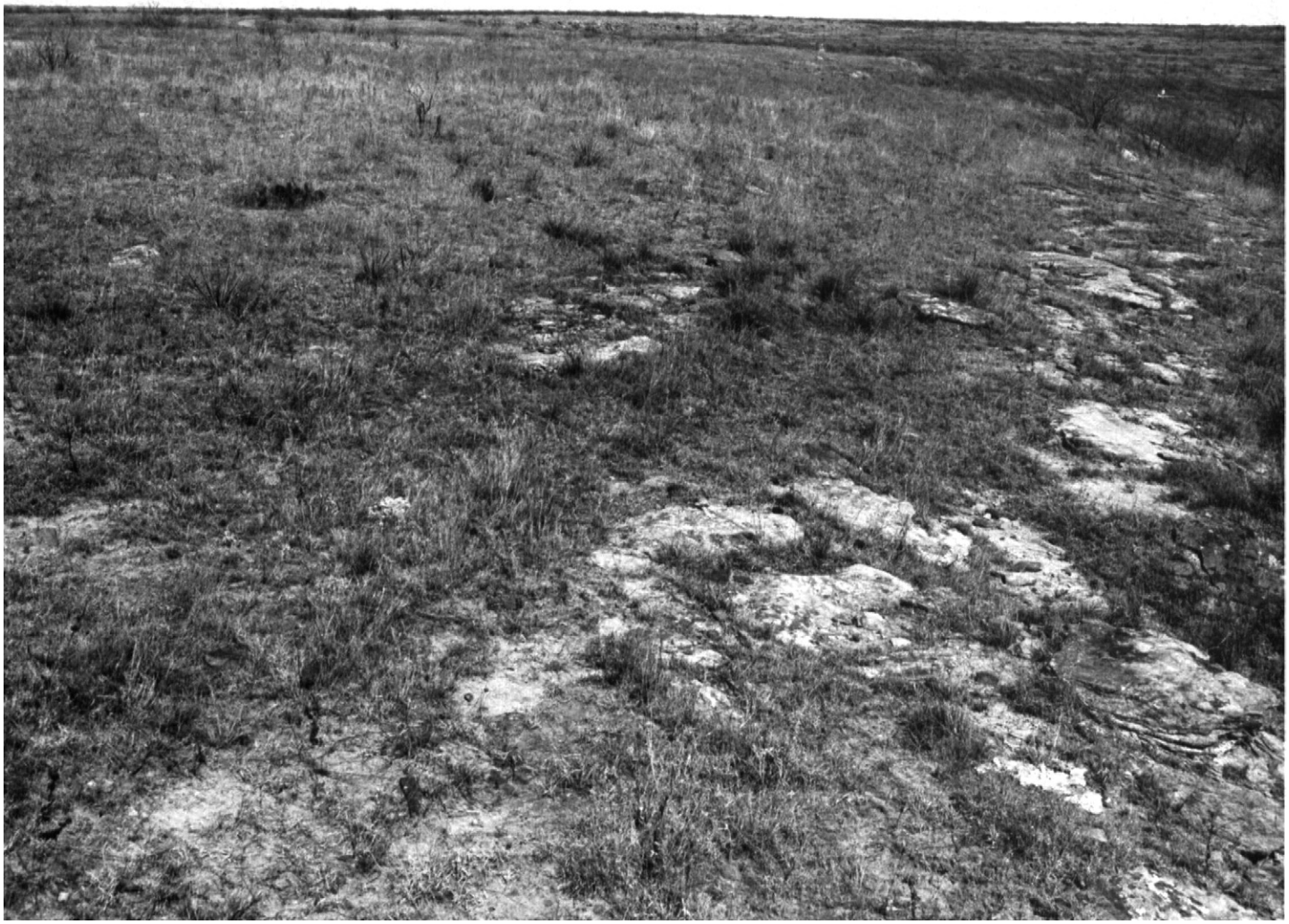

Figure 11.—Typical area of Jolly-Rock outcrop complex, 2 to 12 percent slopes, stony.

feet wide and 1 to 3 feet deep are on the steeper shoulder slopes. They extend to the lower side slopes in about 15 percent of the mapped areas of the unit. Individual areas range from 30 to 950 acres in size.

A typical area of this map unit is 65 percent Jolly soil, 20 percent Rock outcrop, and 15 percent other soils and Oil-waste land. Sandstone fragments averaging 2 feet across typically cover about 5 percent of the surface.

The Jolly soil and flush surface exposures of sandstone bedrock are intermingled throughout this map unit and cannot be separated at the selected scale of mapping. Additional rock outcrop in the form of stones and boulders protrudes above the surface and forms narrow contours on shoulder slopes in about 40 percent of the map unit. These stones and boulders range from 2 to 8 feet across and cover 8 to 35 percent of the surface. The flush sandstone outcrops on summits range from 2 to 12 feet across and cover 1 to 5 percent of the surface. The side slopes below the

rock outcrop contours are covered with 2 to 9 percent flagstones and a few isolated boulders.

Typically, the surface layer of the Jolly soil is brown fine sandy loam about 5 inches thick. The subsoil is reddish brown. The upper 6 inches is sandy clay loam, and the lower 7 inches is sandy clay loam stratified with thin, discontinuous layers of soft sandstone bedrock. The underlying material is pale yellow sandstone bedrock that is weakly cemented in the upper part and strongly cemented in the lower part.

The Jolly soil is well drained. Permeability is moderate, and available water capacity is very low. Surface runoff is medium or rapid depending on the slope. The hazard of wind erosion is slight. The hazard of water erosion is moderate or severe depending on the slope and the percentage of rock at the surface.

Included in this unit in mapping are small areas of Knoco and Vernon soils on the upper side slopes directly below the rock outcrop contours and small areas of Bluegrove and Grandfield soils. Also included are soils on short, steep escarpments that are extremely bouldery and small areas of Oil-waste land.

This map unit is used mainly as rangeland. A few small areas are in pasture. Some areas have been cropped in the past, but most have been converted back to grassland because the soil has eroded and the bedrock has been exposed.

The climax plant community is mid prairie grasses and some tall grasses on shoulder slopes. North-facing slopes have greater potential for supporting plant growth than south-facing slopes since the north-facing slopes receive less direct sunlight. Runoff from areas of exposed rock supplements rainfall and increases yields. A crust tends to form if the surface is left bare. It hinders seed germination and accelerates the rate of erosion. Brush control, reseeding, proper stocking rates, and a planned grazing system improve the quality and increase the quantity of desirable forage. The improved vegetative cover helps to control soil loss and water loss.

Areas of this map unit are inhabited by dove, quail, rabbit, and an occasional coyote, badger, or skunk. Several kinds of woody plants, forbs, and grasses provide good cover, food, and nesting for birds. Turkey often use the steeper side slopes that are adjacent to large river bottoms for escape cover. Grass and forb production is reduced by excessive grazing by wildlife.

Pasture establishment and maintenance is very difficult because of the depth to bedrock, the rock outcrop, and the stones on the surface.

The slope, the depth to bedrock, the rock outcrop, and the stones and boulders on the surface restrict the use of this map unit for most urban and recreational uses. Many areas overlooking bottom land are especially desirable homesites. Proper design and careful installation minimize the effects of most soil restrictions.

This map unit is in capability subclass VIs and the Sandstone Hill range site.

KaA—Kamay silt loam, 0 to 1 percent slopes. This soil is on broad upland plains and ancient stream terraces. Individual areas are irregular in shape and have plane or convex surfaces. They range from 35 to 800 acres in size.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil to a depth of 81 inches is reddish brown clay. It is calcareous below a depth of 18 inches. The underlying material is reddish brown clay that contains common olive shale fragments.

This soil is well drained. Permeability is slow, and available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil in mapping are small areas of Deandale, Hollister, and Tillman soils. Small barren areas of Oil-waste land also are included. Inclusions make up less than 10 percent of the map unit.

Approximately 60 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that are in pasture or are used for nonagricultural purposes.

The climax plant community is short and mid prairie grasses. Potential forage production is limited because the clayey subsoil restricts the growth of roots and the movement of water. This soil is droughty because of the restricted movement of water. A crust quickly develops if the surface is left bare. It hinders emergence of germinating seedlings and accelerates the rate of erosion. A controlled grazing system and brush control help to maintain production of good-quality forage.

The natural vegetation provides habitat for dove, quail, and rabbit. The droughtiness limits production of seed-bearing plants in some years. As a result, food supplies are limited. Areas of mesquite provide good nesting and resting cover for dove.

Suitable crops include cool-season small grain as well as warm-season crops, such as grain sorghum and cotton. Crop yields are limited because of inadequate rainfall in most years and because the growth of roots and the movement of water in the subsoil are restricted. Leaving crop residue on the surface, applying minimum tillage in a timely manner, and using proper crop rotations conserve soil moisture and maintain productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

Suitable pasture grasses include sideoats grama, Johnsongrass, indiangrass, and several varieties of

yellow bluestem. Brush and weed control, proper stocking rates, a deferred grazing system, and timely application of fertilizer improve forage production and quality.

The high content of clay, a high shrink-swell potential, corrosivity to uncoated steel, and the slow permeability are limitations affecting urban development. Proper design and construction and careful installation minimize the effects of these limitations.

This map unit is in capability subclass IIs and the Claypan Prairie range site.

KaB—Kamay silt loam, 1 to 3 percent slopes. This soil is on broad upland plains, low divides, and gently sloping side slopes. Individual areas are irregular in shape and are convex. They range from 20 to 900 acres in size.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil to a depth of 80 inches is reddish brown clay. It is calcareous below a depth of 11 inches. The underlying material is dark reddish brown clay interlayered with light greenish gray shale.

This soil is well drained. Permeability is slow, and available water capacity is high. Surface runoff is medium. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Aspermont and Vernon soils on the steeper, more eroded side slopes; Bluegrove soils on ridges above the Kamay soil; and Deandale and Tillman soils in landscape positions similar to those of the Kamay soil. Also included are small areas of Oil-waste land. Inclusions make up less than 20 percent of the map unit.

About 80 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that have been seeded to pasture or are used for nonagricultural purposes.

The climax plant community is short and mid prairie grasses. Potential forage production is limited because the clayey subsoil restricts the growth of roots and the movement of water. This soil is droughty because of the restricted movement of water. The quality of desirable forage can be improved and the quantity increased with good management practices, such as proper stocking rates, a controlled grazing system, and brush control.

The natural vegetation provides habitat for dove, quail, and rabbit. The droughtiness limits production of seed-bearing plants in some years. As a result, food supplies are limited. Areas of mesquite provide good nesting and resting cover for dove.

This soil is suited to cool-season small grain and warm-season crops. Crop yields are limited in most years because of inadequate rainfall and because the subsoil restricts the growth of roots and the movement of water. Leaving crop residue on the surface, applying minimum tillage in a timely manner, terracing, using proper crop rotations, and farming on the contour conserve soil moisture and help to prevent excessive erosion. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years.

Suitable pasture grasses include indiangrass, Johnsongrass, sideoats grama, and several varieties of yellow bluestem. Brush and weed control, a controlled grazing system, and timely application of fertilizer improve the quality and increase the quantity of desired forage.

The high content of clay, a high shrink-swell potential, corrosivity to uncoated steel, and the slow permeability are limitations affecting urban development. The slope and the hazard of erosion are limitations affecting some recreational uses. Proper design and careful installation minimize the effects of these limitations.

This map unit is in capability subclass IIIe and the Claypan Prairie range site.

KDA—Kamay-Deandale association, saline, 0 to 2 percent slopes. These nearly level to gently sloping soils are on narrow terraces and low divides. They are generally north of a line from Mankins to Holliday. The Kamay soil is on broad, slightly convex, low ridges that serve as drainage divides. The Deandale soil is on flats at the lower elevations and in depressions. Slopes are dominantly less than 0.5 percent but range to 2 percent. Individual areas are broad and irregular in shape. They range from 20 to 750 acres in size.

A typical area of this association is about 45 percent Kamay soil, 25 percent Deandale soil, and 30 percent other soils and Oil-waste land. The soils in this map unit are closely associated and are in a regular, repeating pattern. Individual areas are large enough to map separately; however, since both soils are saline and require similar management, they were not separated during mapping.

Typically, the surface layer of the Kamay soil is brown silt loam about 11 inches thick. The subsoil is reddish brown. It is clay in the upper 7 inches and clay loam in the lower 55 inches. It is calcareous below a depth of 18 inches. The underlying material is yellowish red, calcareous clay that contains shale fragments.

The Kamay soil is well drained. Permeability is slow, and available water capacity is low. Surface runoff is slow. Salinity is moderate or strong. The hazard of wind erosion is slight, and the hazard of water erosion is slight or moderate.

Typically, the surface layer of the Deandale soil is brown silt loam about 12 inches thick. The upper 6 inches of the subsoil is dark brown clay, the next 34 inches is brown clay loam, and the lower 20 inches is reddish brown clay. Below this is reddish brown, calcareous clay.

The Deandale soil is moderately well drained. Permeability is very slow, and available water capacity is low. Surface runoff is slow. Salinity is moderate or strong. The hazards of wind erosion and water erosion are slight.

Included in this unit in mapping are small areas of Port and Wheatwood soils on narrow flood plains. Small areas of Oil-waste land also are included.

This map unit is used as rangeland. Vegetation is spotty and consists mostly of salt-tolerant grasses and scrubby trees. About 20 to 30 percent of the map unit is barren. Some barren areas are the result of damage by heavy machinery and the addition of oil derivatives and byproducts, such as brine, drilling mud, and sludge. Other areas that are near irrigation ditches are barren because of the continuous seepage of salty irrigation water.

Very few wildlife species inhabit areas of this association because of the poor quality of natural vegetation. Habitat management is difficult because the saline soils limit the production and composition of wildlife food and cover. The predominant woody vegetation is scrub mesquite and saltcedar. A few forbs and seed-producing plants grow on these soils. Mourning dove and songbirds use the brush for nesting and roosting. Brush management, a planned grazing system, and other range management techniques help to preserve existing habitat for birds and small mammals.

Only salt-tolerant pasture grasses are suited to these soils. Drought in the summer and the high content of salt severely limit yields. Weed control, a controlled grazing system, and timely application of fertilizer improve the quality and increase the quantity of desirable forage.

These soils are not suitable as cropland. The high content of salt makes the growth of even salt-tolerant crops impractical.

The high content of salt, the slow and very slow permeability, a high shrink-swell potential, and corrosivity to uncoated steel and concrete severely limit these soils for urban and recreational uses. Proper design and careful installation minimize the effects of most of these limitations, but the cost is prohibitive in most cases.

The map unit is in capability subclass VIs and the Saline range site.

KvD—Knoco-Vernon complex, 2 to 12 percent slopes. These soils are on elongated side slopes and in gently rolling headcut areas, most of which are breaks or transitions of uplands to bottom land or drainageways. Short, steep escarpments are at the point of contact of this map unit with the deeper upland soils. Geologic erosion is active with numerous small drainageways and gullies dissecting the map unit. The areas adjacent to drainageways are long and narrow, and the headcut areas are irregular in shape. Areas of the unit range from 20 to about 2,500 acres in size.

A typical area of this map unit is about 45 percent Knoco soil, 25 percent Vernon soil, and 30 percent other soils and Badland. The Knoco soil is on severely eroded knolls and the steeper side slopes. The Vernon soil is on the less sloping, more stable side slopes. Geologic erosion has resulted in much, if not all, of the topsoil being removed. Gravel that was originally in the subsoil covers 25 to 50 percent of the surface. Sandstone cobbles cover as much as 15 percent of the surface. These soils occur as areas so intricately mixed or so small in size that it was not practical to map them separately at the scale used.

Typically, the surface layer of the Knoco soil is reddish brown, calcareous gravelly clay about 3 inches thick. Below this is a 6-inch transitional layer of reddish brown, calcareous clay that is mottled in shades of red, brown, and gray. The underlying material is dusky red, calcareous shale having a clayey texture. It is mottled in shades of brown and gray. Soft masses and concretions of calcium carbonate are common in the topsoil and transitional layer.

The Knoco soil is excessively drained. Permeability is very slow, and available water capacity is very low. Surface runoff is very rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Typically, the surface layer of the Vernon soil is reddish brown, calcareous clay about 4 inches thick. The upper 11 inches of the subsoil is reddish brown, calcareous clay, and the lower 5 inches is mottled weak red and greenish gray, calcareous clay. The underlying material is partially weathered shale having a clayey texture. It is mottled in shades of red and gray. Soft masses and concretions of calcium carbonate are within a depth of 20 inches.

The Vernon soil is well drained. Permeability is very slow, and available water capacity is low. Surface runoff is rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Included in this unit in mapping are small areas of Jolly and Latom soils and rock outcrop on gently sloping ridgetops and shoulder slopes. Also included are areas of Mangum soils on very narrow flood plains along

watercourses; small areas of Oil-waste land; and areas of Badland on very severely eroded knolls, on short, steep escarpments, and on narrow interfluves.

This map unit is used as rangeland. It is not suited to cropland or pasture. Annual production of suitable short and mid range grasses varies depending on the depth of the soil and annual rainfall. Crusting and scalding become severe when vegetation is removed. Brush control and a planned grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of desirable forage. Poor vegetative growth or absence of a vegetative cover results in inadequate food supplies and cover for wildlife.

A high shrink-swell potential, the high content of clay, the slope, low strength, the very slow permeability, corrosivity to uncoated steel, and high erosion potential severely limit the use of these soils for urban and recreational uses.

This map unit is in capability subclass VIIs. The Knoco soil is in the Very Shallow Clay range site, and the Vernon soil is in the Shallow Clay range site.

KvE—Knoco-Vernon complex, 10 to 45 percent slopes, very bouldery. These soils are on steep escarpments and on ridges and buttes that have steep side slopes and gently sloping summits (fig. 12). Slopes range from 1 to 6 percent on the summits, from 30 to 60 percent on the upper side slopes, and from 10 to 30 percent on the lower side slopes and foot slopes. Individual areas are oblong or rounded on ridges and buttes and are long and narrow where the escarpments join the more nearly level uplands. They range from 20 to about 450 acres in size.

A typical area of this map unit is about 35 percent Knoco soil, 30 percent Vernon soil, and 35 percent other soils, Rock outcrop, and Badland. The Knoco and Vernon soils occur as areas so intricately mixed on the side slopes and foot slopes that they could not be separated at the scale selected for mapping. Gullies are on the side slopes and foot slopes at intervals of 35 to 300 feet. They were caused by geologic erosion and are 1 to 8 feet wide and 1 to 5 feet deep. Sandstone bedrock 2 to 12 feet thick forms a cap at the summit of about 75 percent of the mapped areas of the unit. It is being undercut by geologic erosion that results in deposition of rock fragments on the side slopes. The rock fragments are mostly flagstones and boulders and cover 2 to 51 percent of the surface with the highest concentration on the upper slopes. A gravel pavement is on some foot slopes.

Typically, the surface layer of the Knoco soil is reddish brown, calcareous clay about 2 inches thick. The next layer, from a depth of 2 to 9 inches, is reddish brown, calcareous clay. The underlying material is interbedded reddish brown, calcareous clay and light gray platy shale.

The Knoco soil is excessively drained. Permeability is very slow, and available water capacity is very low. Surface runoff is very rapid. The hazard of wind erosion is slight, and the hazard of water erosion is very severe.

Typically, the surface layer of the Vernon soil is brown, calcareous clay about 3 inches thick. The subsoil, from a depth of 3 to 20 inches, is reddish brown, calcareous clay. The underlying material is reddish brown, calcareous clay mottled in shades of gray. It contains fragments of platy shale.

The Vernon soil is well drained. Permeability is very slow, and available water capacity is low. Surface runoff is rapid or very rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Included in this unit in mapping are areas of Badland on side slopes and foot slopes, small areas of Jolly soils on sandstone-capped summits, and small areas of Oil-waste land.

This map unit is used as rangeland. It is not suited to cropland, pasture, or most urban and recreational uses.

The climax plant community is a mixture of mid and tall grasses and scattered woody plants on the upper side slopes, short and mid grasses on the lower side slopes, and mid prairie grasses on the summits. Generally, north-facing slopes support a denser canopy of vegetation than south-facing slopes since the north-facing slopes receive less direct sunlight. Overall production varies depending on the depth of the soil and annual rainfall. Runoff from areas of exposed rock supplements rainfall and improves yields. A planned grazing system that includes adequate deferment of grazing improves the quality and increases the quantity of desirable forage.

Areas of this map unit are inhabited by rabbit, skunk, dove, quail, songbirds, small furbearers, and an occasional coyote. They provide good escape and resting cover in addition to a variety of desirable forb and seed-bearing plants, but poor vegetative growth results in inadequate food supplies. Turkey frequent the areas that are adjacent to large river bottoms but do not inhabit the areas because of the lack of protective cover.

This map unit is in capability subclass VIIs. The Knoco soil is in the Very Shallow Clay range site, and the Vernon soil is in the Shallow Clay range site.

Ma—Mangum clay, occasionally flooded. This nearly level soil is on the flood plains of most major creeks and rivers (fig. 13). Flooding occurs once every 2 to 25 years. Floodwaters remain on the surface for a few hours to as long as 5 days. Additional water is

Figure 12.—A typical area of Knoco-Vernon complex, 10 to 45 percent slopes, very bouldery.

received as runoff from adjacent uplands. Slopes are 0 to 1 percent. Surfaces are plane or slightly concave. Individual areas are elongated and mainly follow the contour of stream channels. They range from 40 to about 1,150 acres in size.

Typically, this soil is calcareous clay throughout. It is brown in the upper 5 inches, reddish brown in the next 36 inches, and brown below a depth of 41 inches. Accumulations of calcium carbonate and a few salt crystals are below a depth of 16 inches. Cracks that formed during dry periods extend from the surface to a depth of about 22 inches.

This soil is well drained. Permeability is very slow, and available water capacity is high. Surface runoff is slow. The root zone is deep, but most roots have difficulty penetrating the clayey soil, especially during the summer. The hazards of wind erosion and water erosion are slight.

Included with this soil in mapping are areas of Mangum, Port, and Wheatwood soils that are frequently flooded and are adjacent to small stream channels or in old sloughs. Also included are areas of Port and Wheatwood soils that are occasionally flooded. Included soils make up about 20 percent of this map unit.

This map unit is used mainly as rangeland. The climax plant community consists of mid grasses. Scattered trees are common along drainage channels. Brush control, reseeding, and a planned grazing system help to maintain productivity.

Several kinds of woody plants and seed-producing forbs and grasses provide good cover, feed, and resting areas for dove, quail, coyote, small furbearers, and songbirds. Bands of trees and shrubs adjacent to the larger creek channels are used as travel lanes and escape cover by deer and turkey in the southern and western parts of the county.

Kleingrass, indiangrass, switchgrass, big bluestem, Johnsongrass, tall wheatgrass, western wheatgrass, and several varieties of yellow bluestem are suitable pasture grasses. A hard crust forms on the surface after periods of heavy rainfall. It makes establishment of grasses difficult. Weed control, a controlled grazing

Figure 13.—An area of Mangum clay, occasionally flooded, on a flood plain in the middle ground. Jolly-Rock outcrop complex, 2 to 12 percent slopes, stony, is in the foreground and background.

system, and timely application of fertilizer improve the quality and increase the quantity of forage.

Cool-season small grain grows well on this soil. Warm-season crops can be grown, but short periods of drought in the summer reduce yields in most years. A hard crust forms on the surface after periods of heavy rainfall. It hinders emergence of germinating seed and reduces the rate of infiltration. The occasional flooding restricts plant growth and germination and can destroy entire fields of crops if it occurs during critical growth stages. Leaving crop residue on the surface, using proper crop rotations, and applying minimum tillage in a timely manner help to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer according to soil tests increases yields in some years. Areas included in this map unit that are adjacent to river and creek channels and depressional areas that have a potential for more frequent flooding should not be cropped.

This soil is poorly suited to most urban and recreational uses. The hazard of flooding, a high shrink-swell potential, and the very slow permeability are some of the limitations.

This map unit is in capability subclass IIIw and Clayey Bottomland range site.

Mc—Mangum clay, frequently flooded. This nearly level soil is on the flood plains of most major creeks and rivers. Slopes are dominantly less than 0.5 percent but range to 1.0 percent. Flooding occurs about three times each year. Floodwaters remain on the surface for a few hours to as long as 5 days. Some narrow benches that are slightly higher flood only once in 2 or 3 years. Individual areas are narrow and elongated and have plane or concave surfaces. They are about 40 to 500 acres in size.

Typically, this soil is clayey throughout. It is brown in the upper 8 inches, dark brown in the next 12 inches, and dominantly reddish brown in the lower 60 inches. A dark grayish brown layer, apparently a buried surface layer, is between depths of 34 and 58 inches. Cracks are common from the surface to a depth of about 20 inches. Accumulations of calcium carbonate and a few salt crystals are below a depth of 34 inches.

This soil is moderately well drained. Permeability is very slow, and available water capacity is high. Surface runoff is very slow. The root zone is deep, but most roots have difficulty penetrating the clayey soil. The hazards of wind erosion and water erosion are slight.

Included with this soil in mapping are small areas of Port soils in landscape positions similar to those of the Mangum soil and narrow bands of Mangum soils that are only flooded occasionally. Included soils make up about 25 percent of this map unit.

This soil is used only as rangeland. It is not suited to cropland and is poorly suited to pasture because of the frequent flooding. Severe crusting also is a problem.

The climax plant community consists of short and mid grasses and scattered forbs, shrubs, and trees. Brush control and a planned grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of desirable forage. Reestablishing a grass cover is very difficult since the soil has a tendency to form a thick crust if it is left bare.

Areas of this map unit are used extensively by dove, quail, rabbit, squirrel, coyote, turkey, and deer for resting cover and as travel lanes. They are seldom used as habitat, however, because they lack good seed-producing grasses and forbs.

This soil is poorly suited to most urban and recreational uses. The very slow permeability, the clayey texture, the flooding, a high shrink-swell potential, low load-bearing strength, and high corrosivity to uncoated steel are difficult to overcome.

This map unit is in capability subclass Vw and Clayey Bottomland range site.

Mw—Mangum-Wheatwood complex, occasionally flooded. These nearly level soils are on flood plains. They flood an average of about once every 6 years. Slopes are dominantly less than 0.5 percent. Individual areas range from 60 to 640 acres in size.

A typical area of this map unit is about 50 percent Mangum soil, 45 percent Wheatwood soil, and 5 percent other soils. The Mangum soil is in low areas, swales, and depressions. The Wheatwood soil is mainly in the slightly higher areas adjacent to stream channels.

The soils in this map unit are closely associated. Their pattern of occurrence is irregular. Individual areas of both soils are small and are difficult to map separately. Most mapped areas contain both soils, but a few contain only one or the other of the soils.

Typically, the surface layer of the Mangum soil is reddish brown silty clay about 6 inches thick. The subsoil to a depth of 18 inches is reddish brown clay. The soil below is yellowish red and calcareous. It is 14 inches of silty clay loam, 14 inches of silt loam, and 28 inches of very fine sandy loam. The range of texture in the surface layer includes silty clay loam and clay.

The Mangum soil is moderately well drained. Permeability is very slow, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Typically, the surface layer of the Wheatwood soil is reddish brown silty clay loam about 12 inches thick. The soil between depths of 12 and 40 inches is reddish brown silt loam. Below this are alternating layers of dominantly yellowish red silty clay loam and very fine

sandy loam. These layers are 2 to 4 inches thick and include a few thinner layers of fine sandy loam. The range of texture in the surface layer includes silt loam.

The Wheatwood soil is well drained. Permeability is moderate, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Included in this unit in mapping are small areas of Port soils in landscape positions similar to those of the Mangum and Wheatwood soils and narrow sloughs that flood frequently.

Most of this map unit is rangeland. The climax plant community consists of mid grasses and scattered forbs and trees. Denser bands of trees and shrubs are adjacent to stream channels. Additional moisture, which is received in the form of runoff from adjacent slopes and occasional stream overflow, increases the production potential in the map unit. Brush control, reseeding, and a planned grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of the more desirable forage plants.

Several of the woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and seeds for songbirds, furbearers, game birds, and animals. Bands of trees and shrubs adjacent to creek channels are used as escape cover and travel lanes by deer, coyote, and turkey. Grass and forb production is reduced by excessive grazing by livestock.

Suitable pasture grasses are kleingrass, indiangrass, big bluestem, Johnsongrass, tall wheatgrass, western wheatgrass, and several varieties of yellow bluestem. A hard crust forms after periods of heavy rainfall. It makes establishment of grasses difficult. Weed control, a controlled grazing system, and timely application of fertilizer improve forage production.

Cool-season small grain and some warm-season crops can be grown on these soils, but yields are limited by frequent droughts, especially during the summer. A crust forms after periods of heavy rainfall. It hinders emergence of germinating seed and reduces the rate of infiltration. Leaving crop residue on the surface when crops are not being grown, applying minimum tillage in a timely manner, and using proper crop rotations help to control erosion and conserve soil moisture. Crop residue management helps to maintain soil productivity and tilth and minimize soil crusting. Timely application of fertilizer according to soil tests increases yields in most years. Areas adjacent to small creeks that have a high potential for flooding should not be used as cropland.

This map unit is poorly suited to most urban and recreational uses. The hazard of flooding, a high shrink-swell potential, and the moderate or very slow permeability are some of the limitations that are difficult to overcome.

This map unit is in capability subclass IIIw. The Mangum soil is in the Clayey Bottomland range site, and the Wheatwood soil is in the Loamy Bottomland range site.

Ow—Oil-waste land. Oil-waste land consists of areas of soils that have been affected by oil field activity. These areas are on most of the kinds of soil in the county. They were mapped as a separate unit if they were larger than 5 acres in size. Slopes dominantly are 0 to 3 percent but range to 45 percent. Individual areas range from 5 to 80 acres in size.

Oil-waste land has been damaged by heavy machinery and the addition of oil derivatives and byproducts, such as brine, drilling mud, and sludge (fig. 14). Its productivity has been drastically reduced or destroyed depending on the kind and amount of damage received and the length of exposure to the damaging agent. Concentrations of soluble salts in the upper 6 inches of the surface range from 6 to 40,000 parts per million. Some areas have partially recovered or have been reclaimed, but vegetative cover is sparse and of poor quality. Most areas do not have a vegetative cover. Wind erosion and water erosion have thinned or removed the surface layer in most areas. Gullies 3 to 5 feet deep and 6 to 12 feet wide have formed in most areas where the slope is more than 1.5 percent and in areas adjacent to stream channels.

Oil-waste land is not suited to any use that requires the production of vegetation, to any urban or recreational uses, or to habitat for wildlife.

This map unit is in capability subclass VIIIs. No range site has been assigned.

Po—Port-Wheatwood complex, occasionally flooded. These soils are on flood plains along creeks and small, intermittent streams. Flooding occurs once every 2 to 6 years. Floodwaters remain on the surface from a few hours to as long as 5 days. Slopes are 0 to 1 percent. Surfaces are plane to very gently undulating. Individual areas range from 100 to several thousand feet wide and are often several miles long. They are dissected by shallow or moderately deep channels that meander throughout the flood plain. They range from 30 to about 300 acres in size.

A typical area of this map unit is about 45 percent Port and similar soils, 35 percent Wheatwood and similar soils, and 20 percent other soils. The soils in the map unit are closely associated. Their pattern of occurrence is irregular. In some places individual areas of both soils are large enough to be mapped separately.

Figure 14.—A typical area of Oil-waste land. It was formerly an area of Kamay silt loam, 1 to 3 percent slopes.

In other places the soils occur as areas so intricately mixed that they cannot be separated at the selected scale of mapping. Most mapped areas contain both soils, but a few contain only one or the other of the soils.

Typically, the surface layer of the Port soil is dark brown silty clay loam about 21 inches thick. The subsoil to a depth of 39 inches is brown silty clay loam. The underlying material to a depth of 80 inches is yellowish red, calcareous loam stratified with thin layers of finer textured material.

Typically, the surface layer of the Wheatwood soil is brown silty clay loam about 9 inches thick. The upper 9 inches of the subsoil is reddish brown silty clay loam, and the lower 6 inches is reddish brown loam. The underlying material is light reddish brown. The upper 10 inches is calcareous silt loam. Below that is calcareous fine sandy loam stratified with thin layers of coarser and finer textured material.

The Port and Wheatwood soils are well drained. Permeability is moderate, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Included in this unit in mapping are small, frequently flooded areas of Mangum, Port, and Wheatwood soils adjacent to stream channels and in old sloughs. Also included are some areas of Mangum soils that are only occasionally flooded and small areas of Oil-waste land that originate at wells and tank batteries and parallel stream channels for several hundred feet.

Most of the acreage of this map unit is used as rangeland. About 10 percent is used as cropland, and a few small areas are in pasture.

The climax plant community is mid grasses and a few forbs and low-growing shrubs and larger trees adjacent to stream channels. Additional moisture is received in the form of runoff from adjacent slopes and occasional stream overflow. The density of woody vegetation varies with the amount and frequency of extra water received. These soils respond well to brush control and reseeding. Proper stocking rates and a planned grazing system improve the quality and

increase the quantity of desirable forage.

These soils supply good habitat for dove, quail, songbirds, and squirrel throughout the county and for turkey and deer along the larger creeks. Several of the woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and seed for songbirds, furbearers, game birds, and animals. Bands of trees and shrubs adjacent to creek channels are used as escape cover and travel lanes by deer, turkey, and coyote. Habitat quality can be improved through brush control and by plant selection. Grass and forb production is reduced by excessive grazing by wildlife.

Suitable pasture grasses include sideoats grama, Johnsongrass, kleingrass, and several varieties of yellow bluestem. Weed and brush control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer improve forage quality and increase yields.

Crusting after periods of heavy rainfall is a problem on these soils when they are cropped. This crust becomes hard when dry and reduces the rate of infiltration, increases the rate of erosion, and impedes the emergence of seedlings. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface conserve soil moisture and help to control erosion. Crop residue management helps to maintain soil productivity and tilth and prevent crusting. Timely application of fertilizer according to soil tests increases yields in most years. Frequently flooded areas along stream channels and in sloughs and swales should not be cropped.

The hazard of flooding on this map unit limits most urban and recreational uses.

This map unit is in capability subclass IIw. The Port soil is in the Draw range site, and the Wheatwood soil is in the Loamy Bottomland range site.

Pw—Port and Wheatwood soils, frequently flooded. These soils are on flood plains along creeks and small, intermittent streams. Flooding occurs three to five times each year. Floodwaters remain on the surface from a few hours to several days. Slopes are 0 to 1 percent. Surfaces are plane to very gently undulating. Individual areas range from 100 to 2,000 feet wide and are often several miles long. They are dissected by shallow or moderately deep channels that meander throughout the flood plain. They range from 40 to about 1,100 acres in size.

A typical area of this map unit is about 45 percent Port and similar soils, 40 percent Wheatwood and similar soils, and 15 percent other soils. The soils in the map unit are closely associated. Their pattern of occurrence is irregular. In some places individual areas of both soils are large enough to be mapped separately. In other places the soils are in areas so intricately mixed that they cannot be separated at the selected scale of mapping. Most mapped areas contain both soils, but some contain only one or the other of the soils.

Typically, the surface layer of the Port soil is reddish brown silty clay loam about 21 inches thick. The subsoil to a depth of 59 inches is reddish brown silty clay loam. The underlying material is reddish brown, calcareous, silty clay loam stratified with thin layers of very fine sandy loam, loam, silt loam, and silty clay. The range of the texture of the surface layer includes silt loam, loam, clay loam, and silty clay.

Typically, the surface layer of the Wheatwood soil is reddish brown silty clay loam about 10 inches thick. The subsoil to a depth of 48 inches is yellowish red, calcareous silt loam. The underlying material is yellowish red, stratified, calcareous silt loam, silty clay loam, clay loam, loam, and silty clay. The range of the texture of the surface layer includes very fine sandy loam, silt loam, loam, clay loam, and silty clay.

The Port and Wheatwood soils are well drained. Permeability is moderate, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Included in this unit in mapping are small areas of Mangum soils in swales and narrow sloughs. Also included are small areas of Oil-waste land that originate at wells or tank batteries and parallel stream channels for several hundred feet.

This map unit is used as rangeland. It is not used as cropland or for urban and recreational development because of the flooding. Additional moisture, which is received in the form of runoff from adjacent slopes and frequent stream overflow, increases the potential production of mid and tall grasses and of the few forbs and low-growing shrubs. Larger trees are along most creek channels. The density of these woody plants varies with the amount and frequency of extra water received. These soils respond well to brush control and reseeding. Proper stocking rates and a planned grazing system improve the quality of desirable forage and increase yields.

These soils supply fair habitat for dove, quail, songbirds, and squirrel throughout the county and for turkey and deer along the larger creeks. Several of the woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and seed for songbirds, furbearers, game birds, and animals. Bands of trees and shrubs adjacent to creek channels are used as escape cover and travel lanes by deer, turkey, and coyote. Habitat quality can be improved through brush control and by plant selection. Grass and forb production is reduced by excessive grazing by livestock.

These soils are well suited to pasture grasses. Suitable species include bermudagrass, indiangrass, Johnsongrass, kleingrass, sideoats grama, western wheatgrass, tall wheatgrass, and many varieties of yellow bluestem. A crust tends to form after periods of heavy rainfall if the soils are left bare. It reduces the rate of infiltration, increases the rate of erosion, and impedes the emergence of seedlings. Brush and weed control, proper stocking rates, a controlled grazing system, and timely application of fertilizer according to soil tests improve forage quality and increase production.

This map unit is in capability subclass Vw. The Port soil is in the Draw range site, and the Wheatwood soil is in the Loamy Bottomland range site.

RoA—Rotan silty clay loam, 0 to 1 percent slopes. This nearly level soil is on broad, flat plains in the uplands. Surfaces are slightly convex to slightly concave. Individual areas are irregular in shape. They range from 30 to about 2,250 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil is calcareous clay. It is dark grayish brown in the upper 21 inches, dark brown in the next 18 inches, reddish yellow in the next 28 inches, and yellowish red in the lower 15 inches. Accumulations of calcium carbonate are throughout the subsoil but are concentrated between depths of 47 and 75 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil in mapping are small areas of Aspermont soils on the steeper side slopes adjacent to watercourses and on shoulder slopes that grade to escarpments. Also included are areas of Rowden soils on gently sloping, convex ridges and side slopes; areas of Rotan soils that have a slope of more than 1 percent; and small areas of Oil-waste land. Inclusions make up about 10 percent of this map unit.

About 70 percent of the acreage of this map unit is used as cropland. The remaining acreage is rangeland, except for a few small areas that are used for nonagricultural purposes. Small grain and cotton are the main crops (fig. 15). Drought in the summer limits yields in some years. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the soil help to control erosion, conserve moisture, and maintain productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

This soil is well suited to pasture. The best suited plants include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. Weed control, a controlled grazing system that includes adequate deferment of grazing, brush management, and timely application of fertilizer increase the quantity and improve the quality of forage in most years.

The climax plant community consists of short and mid grasses. This soil responds well to brush control and reseeding. A crust forms after periods of heavy rainfall. It hinders emergence of germinating seed. Proper stocking rates and a deferred grazing system increase forage production and quality.

If used for native range, areas of this soil are inhabited by dove, quail, rabbit, and an occasional coyote or skunk. A wide variety of seed-producing forbs and grasses supply ample food supplies, and scattered shrubs and scrubby trees offer protective nesting and resting cover.

The high content of clay, the moderately slow permeability, low load-bearing strength, a high shrink-swell potential, and corrosivity to uncoated steel limit the use of this soil for urban development. Proper design and careful installation, however, minimize the effects of these limitations.

This soil is in capability subclass IIc and the Clay Loam range site.

RoB—Rotan silty clay loam, 1 to 3 percent slopes. This gently sloping soil is on broad divides and short side slopes. Individual areas are irregular in shape and are convex. They range from 20 to about 250 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The subsoil is clay. It is dark brown in the upper 23 inches, very pale brown in the next 17 inches, and reddish yellow in the lower 33 inches. Calcium carbonate in the form of soft masses and concretions is below a depth of 13 inches with the greatest concentration between depths of 30 and 47 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is slow or medium. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

Included with this soil in mapping are small areas of Aspermont soils on strongly sloping side slopes adjacent to watercourses and on shoulder slopes grading to escarpments. Also included are Rowden soils in landscape positions similar to those of the Rotan soil and small areas of Oil-waste land. Inclusions make up about 10 percent of this map unit.

This map unit is dominantly used as cropland. Small grain and cotton are the main crops. Drought in the summer limits yields in some years. Terracing, contour

Figure 15.—Cotton ready for harvest in an area of Rotan silty clay loam, 0 to 1 percent slopes.

farming, using proper crop rotations, and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain productivity and tilth. Cultivation should be timely and limited. Timely application of fertilizer increases yields in most years.

The best suited pasture plants include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. A crust forms after periods of heavy rainfall. It makes establishment of grasses difficult. Weed control, a controlled grazing system that includes adequate deferment of grazing, brush management, and timely application of fertilizer increase the quantity and improve the quality of forage in most years.

This soil produces high yields of native range forage if good management practices are applied. These practices include proper stocking rates, a controlled grazing system, and brush control.

If used for native range, areas of this soil provide good habitat for dove, quail, coyote, rabbit, and skunk. A wide variety of natural vegetation furnishes ample food supplies and protective nesting and resting cover.

The high content of clay, the moderately slow permeability, low strength, a high shrink-swell potential, and corrosivity to uncoated steel limit the use of this soil for urban development. Proper design and careful installation, however, minimize the effects of these limitations.

This map unit is in capability subclass IIe and in the Clay Loam range site.

RwB—Rowden clay loam, 1 to 3 percent slopes. This gently sloping soil is on low, broad ridges and side slopes. Individual areas are irregular in shape and are convex. They range from 40 to about 200 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 7 inches thick. The subsoil to a depth of 30 inches is dark brown, calcareous clay. The underlying material is limestone bedrock.

This soil is well drained. Permeability is slow, and available water capacity is low. Surface runoff is medium. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

Included with this soil in mapping are small areas of Aspermont soils on the steeper side slopes adjacent to watercourses and areas of soils that have 15 to 50 percent limestone gravel and cobbles on the surface. Included soils make up about 10 percent of this map unit.

About 50 percent of the acreage of this map unit is used as cropland. The remaining acreage is used as rangeland. Small grain and cotton are the main crops. Crop yields are limited in most years because of drought in the summer and the low available water capacity. A crust forms after periods of heavy rainfall. It increases the rate of erosion and decreases the rate of infiltration. Using proper crop rotations, terracing, applying minimum tillage in a timely manner, and managing crop residue help to control erosion, minimize crusting, conserve moisture, and maintain productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

This soil is well suited to pasture. The best suited plants include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. The establishment of grasses is hampered by crusting. Weed control, a controlled grazing system that includes adequate deferment of grazing, brush management, and timely application of fertilizer increase the quantity and improve the quality of forage.

This soil produces high yields of short to mid range grasses if good management practices are applied. These practices include proper stocking rates, a controlled grazing system, and brush control.

This soil produces good habitat for openland wildlife including dove, quail, rabbit, coyote, and skunk. A wide variety of natural vegetation furnishes a good supply of food as well as protective nesting and resting cover.

The depth to bedrock, the high content of clay, the slow permeability, low strength, a high shrink-swell potential, and corrosivity to uncoated steel limit the use of this soil for urban development. These limitations are difficult to overcome. The soil is well suited to most recreational uses.

This soil is in capability subclass IIIe and the Clay Loam range site.

TcA—Tillman clay loam, 0 to 1 percent slopes. This soil is in broad, flat areas that have plane surfaces. Individual areas are irregular in shape. They range from 35 to about 1,500 acres in size.

Typically, the surface layer is dark brown clay loam about 8 inches thick. The subsoil is clay. It is dark brown in the upper 6 inches, brown in the next 16 inches, and reddish brown in the lower 46 inches. The underlying shaly material is mottled in shades of brown, red, and gray. Concentrations of calcium carbonate are below a depth of 14 inches. Salt crystals are below a depth of 30 inches.

This soil is well drained. Permeability is slow, and available water capacity is high. Surface runoff is slow. The hazards of water erosion and wind erosion are slight.

Included with this soil is mapping are small areas of Hollister and Deandale soils in small depressional areas and in landscape positions similar to those of the Tillman soil. Also included are areas of a Tillman soil that has a slope of more than 1 percent and small areas of Oil-waste land. Inclusions make up less than 10 percent of this map unit.

Approximately 70 percent of the total acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that are seeded to pasture or are used for nonagricultural purposes.

The climax plant community consists of short and mid prairie grasses. This soil responds well to brush control and reseeding. Use of proper stocking rates and a controlled grazing system that includes adequate deferment of grazing increase the quantity and improve the quality of desirable forage.

The natural vegetation on this soil provides good cover and adequate food supplies for dove, quail, prairie dog, coyote, rabbit, and skunk. Areas of mesquite provide good nesting and resting cover for dove.

Suitable pasture grasses include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. Brush and weed control, a planned grazing system, and timely application of fertilizer increase yields and improve forage quality in most years.

Crop yields are limited in most years because of drought, especially during the summer. A crust tends to form after periods of heavy rainfall if the surface is left bare. It reduces the rate of infiltration and impedes the emergence of seedlings. Using proper crop rotations,

applying minimum tillage in a timely manner, and leaving crop residue on the surface conserve soil moisture and help to control erosion. Crop residue management helps to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer according to soil tests increases yields in most years.

The slow permeability, the high content of clay, a high shrink-swell potential, low load-bearing strength, and corrosivity to uncoated steel adversely affect most urban uses of this soil. Proper design and careful installation minimize the effects of most of these limitations.

This map unit is in capability subclass IIs and the Clay Loam range site.

TcB—Tillman clay loam, 1 to 3 percent slopes. This soil is on broad upland plains, low divides, and gently sloping side slopes. Individual areas are irregular in shape and are convex. They range from 25 to about 450 acres in size.

Typically, the surface layer is dark brown clay loam about 6 inches thick. The subsoil is clay. It is dark brown in the upper 9 inches, reddish brown in the next 44 inches, and yellowish red in the lower 14 inches. The underlying shaly material is mottled in shades of brown, red, and gray. Concentrations of calcium carbonate are below a depth of 15 inches. Salt crystals are below a depth of 33 inches.

This soil is well drained. Permeability is slow, and available water capacity is high. Surface runoff is medium. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Aspermont soils on eroded shoulder slopes, areas of Kamay and Wichita soils in landscape positions similar to those of the Tillman soil, and small areas of Oil-waste land. Inclusions make up about 10 percent of this map unit.

Approximately 70 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that are seeded to pasture grasses or are used for nonagricultural purposes.

The climax plant community is short and mid prairie grasses. This soil responds well to brush control and reseeding. Proper stocking rates and a planned grazing system that includes adequate deferment of grazing improve the quality and quantity of desirable forage.

Dove, quail, small furbearers, and an occasional coyote, skunk, or prairie dog inhabit areas of this map unit. The number of dove and quail increases with an increase in the amount of shrubby and woody vegetation, which provides escape and nesting cover. Habitat quality can be improved by brush control and by selection of desirable grass and forb species for range seeding.

The best suited pasture grasses include sideoats grama, Johnsongrass, kleingrass, and most varieties of yellow bluestem. Brush and weed control, a controlled grazing system, and timely application of fertilizer improve yields and forage quality.

When it is cropped, this soil is best suited to cool-season small grain. Production of warm-season crops is limited in most years because of drought in the summer. A crust tends to form after periods of heavy rainfall if the surface is left bare. It reduces the rate of infiltration, increases the rates of runoff and erosion, and impedes the emergence of seedlings. Crop residue management, minimum tillage, crop rotations, terraces, and contour farming help to control erosion and conserve soil moisture. Crop residue management also helps to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer increases yields in most years.

The slow permeability, the high content of clay, a high shrink-swell potential, low strength, and corrosivity to uncoated steel adversely affect most urban uses of this soil. Proper design and construction and careful installation minimize the effects of most soil restrictions.

This map unit is in capability subclass IIIe and the Clay Loam range site.

VeC—Vernon clay, 1 to 5 percent slopes. This soil is on side slopes and in undulating headcut areas that are transition areas between uplands and bottom land and on knolls and low ridges in the uplands. The surface layer has been thinned in many places by water erosion and in some places has almost been completely eroded. In places where erosion is active, gravel-sized concretions originally in the surface layer and subsoil cover from 5 to 20 percent of the surface. Individual areas are narrow and elongated on the side slopes and oblong to rounded on the knolls and ridges. They range from 15 to about 240 acres in size.

Typically, the surface layer is brown clay about 5 inches thick. The upper 25 inches of the subsoil is reddish brown clay, and the lower 5 inches is mottled weak red, light reddish brown, and light olive gray clay. The upper 5 inches of the underlying material is mottled weak red, reddish brown, and light olive, weathered shale that has a clayey texture. Below 40 inches the underlying material is dominantly weak red, weathered shale that has a clayey texture. It is stratified with light gray platy shale. This soil is calcareous throughout. Soft masses and concretions of calcium carbonate are common in the surface layer and subsoil. In places the surface layer is clay loam.

This soil is well drained. Permeability is very slow,

and available water capacity is low. Surface runoff is rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Included with this soil in mapping are small areas of Jolly and Knoco soils, areas of rock outcrop on shoulder slopes, and small areas of Oil-waste land. Inclusions make up about 10 percent of this map unit.

This map unit is used mainly as rangeland. A few small areas are cropped, but the surface layer of the soil erodes rapidly if it is not protected by a vegetative cover.

The climax plant community includes short and mid grasses and scattered brush. This soil responds well to brush control and reseeding. If the soil is left bare, it is subject to scalding and crusting; consequently, the germination of grasses is poor and the hazard of erosion is increased. Proper stocking rates and a controlled grazing system improve the quality and increase the quantity of desirable forage.

Wildlife species under native range conditions include dove, quail, rabbit, and an occasional coyote, skunk, or badger. A wide variety of natural vegetation is suitable, but growth and yields are limited. This natural vegetation provides adequate nesting and resting cover, as well as some food supplies. The amount of seed produced by grasses and forbs is reduced by excessive grazing by wildlife.

This soil responds well to reseeding of pasture grasses. Brush and weed control, a controlled grazing system, and timely application of fertilizer improve the quality and increase the quantity of desirable forage. Suitable grasses include sideoats grama, kleingrass, Johnsongrass, and several varieties of yellow bluestem.

This soil is suited only to cool-season small grain if it is used for cultivated crops. A crust readily forms if the soil is left bare. It reduces the rate of infiltration, increases the hazard of erosion, and impedes seed germination and seedling emergence. Leaving crop residue on the surface, applying minimum tillage, terracing, and contour farming help to control erosion and conserve moisture. Crop residue management helps to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer according to soil tests increases yields in most years.

Low load-bearing strength, a high shrink-swell potential, the very slow permeability, the high erosion potential, the high content of clay, and corrosivity to uncoated steel limit the use of this soil for urban and recreational development. Proper design and careful installation, however, minimize the effects of these limitations.

This map unit is in capability subclass IVe and the Shallow Clay range site.

VkD—Vernon-Knoco complex, 2 to 8 percent slopes. These soils are on elongated side slopes and in undulating headcut areas, most of which are breaks or transitions between uplands and bottom land or drainageways. The areas adjacent to drainageways are long and narrow, and the headcut areas are irregular in shape. They range from 30 to about 300 acres in size.

A typical area of this map unit is 70 percent Vernon soil, 25 percent Knoco soil, and 5 percent other soils and Oil-waste land. The Vernon soil is on gently sloping, convex side slopes; in concave swales; and on interfluves. The Knoco soil is on knolls, sloping side slopes, and severely eroded interfluves. Geologic erosion is active. As a result of erosion, the surface soil is thin and concentrations of gravel-sized concretions, which were originally in the subsoil, cover 5 to 40 percent of the surface. These soils occur as areas so intricately mixed that it was not practical to map them separately at the scale used.

Typically, the surface layer of the Vernon soil is dark brown, calcareous clay about 4 inches thick. The subsoil to a depth of 23 inches is reddish brown, calcareous clay that has common concretions of calcium carbonate. The upper 4 inches of the underlying material is reddish gray, calcareous clay. The underlying material below a depth of 27 inches is weathered shale that has a clayey texture. It is mottled in shades of yellow and gray.

The Vernon soil is well drained. Permeability is very slow, and available water capacity is low. Surface runoff is rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Typically, the surface layer of the Knoco soil is reddish brown, calcareous clay about 3 inches thick. The underlying material is mottled gray, reddish brown, and brownish yellow, calcareous clay in the upper 6 inches and gray, calcareous shale in the lower part. Gravel-sized concretions cover 10 to 40 percent of the surface.

The Knoco soil is excessively drained. Permeability is very slow, and available water capacity is very low. Surface runoff is very rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Included in this unit in mapping are small areas of Jolly soils and rock outcrop on gently sloping ridgetops and shoulder slopes; areas of Mangum, Port, and Wheatwood soils on very narrow flood plains; and small areas of Oil-waste land. Inclusions make up about 5 percent of the mapped areas.

This map unit is used as rangeland. Production of short and mid grasses varies depending on the depth of the soil and annual rainfall. Severe crusting and erosion

occur when vegetation is removed. Brush control and a planned grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of desirable forage.

This map unit is not suited to cropland and is poorly suited to pastureland and hayland. Droughtiness makes establishment of pasture grasses difficult. Because of the droughtiness and the low or very low available water capacity, yields are generally low.

Areas of this map unit are inhabited by dove, quail, and rabbit. Existing vegetation provides food and cover for quail and rabbit. Areas of mesquite provide good nesting and resting areas for dove. Turkey and coyote traverse these areas but do not inhabit them.

A high shrink-swell potential, the high content of clay, the slope, low strength, the slow or very slow permeability, corrosivity to uncoated steel, and the droughtiness limit the use of this map unit for urban and recreational uses.

This map unit is in capability subclass VIe. The Vernon soil is in the Shallow Clay range site, and the Knoco soil is in the Very Shallow Clay range site.

VID—Vernon-Latom complex, 3 to 12 percent slopes, stony. These soils are on gently sloping to strongly sloping, low breaks, ridges, and eroded side slopes that are capped in places by calcareous sandstone bedrock. Slopes range from 3 to 8 percent on the summit of ridges and knolls, from 5 to 12 percent on side slopes and interfluves, and to as much as 20 percent in areas where the upper side slopes are capped by sandstone bedrock. The ridges and the steeper side slopes are long and narrow, and the lower side slopes and interfluves are irregular or fan shaped. Surfaces are mainly convex but become uneven on the lower side slopes. Gullies, which were caused by geologic erosion, are 1 to 6 feet wide and 1 to 4 feet deep. They are on the side slopes at intervals of 35 to 300 feet. A layer of calcareous sandstone bedrock 6 inches to 2 feet thick forms a cap on the summit of most ridges and knolls. It is being undercut by geologic erosion, which results in the deposition of rock fragments on the lower slopes. The rock fragments are mostly flagstones, but they also include boulders. They cover an average of about 14 percent of the surface with the highest concentration on the upper side slopes. The rock fragments on the lower side slopes are mostly sandstone cobbles and gravel-sized concretions. Individual areas of these soils range from 40 to about 200 acres in size.

A typical area of this map unit is 35 percent Vernon soil, 30 percent Latom soil, and 35 percent other soils, Badland, and rock outcrop. The Vernon soil is on side slopes and interfluves. The Latom soil is on the crest of ridges and the summit of small, rounded knolls. These soils occurs as areas that are too small to be separated at the scale selected for mapping.

Typically, the surface layer of the Vernon soil is reddish brown clay about 5 inches thick. The subsoil to a depth of 18 inches is reddish brown clay that has grayish brown mottles. The underlying material is stratified reddish brown, red, olive, and gray clay and shale interlayered with soft sandstone bedrock. This soil is calcareous throughout.

The Vernon soil is well drained. Permeability is very slow, and available water capacity is low. Surface runoff is rapid. The hazard of wind erosion is slight, and the hazard of water erosion is severe.

Typically, the surface layer of the Latom soil is reddish brown fine sandy loam about 6 inches thick. The underlying material is weakly consolidated sandstone bedrock that increases in hardness with increasing depth. Sandstone bedrock outcrops that are flush with the surface comprise 9 percent of the surface area. This soil is calcareous throughout.

The Latom soil is well drained. Permeability is moderate, and available water capacity is very low. Surface runoff is medium or rapid depending on the slope gradient. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Included in this unit in mapping are small areas of Knoco soils and Badland on the steeper side slopes and Mangum soils in narrow drainageways. Also included are areas where sandstone outcrops and the short, steep escarpments just below these rock outcrops and small areas of Oil-waste land.

This map unit is used as rangeland. It is not suited to cropland, pastureland, or most urban or recreational uses because of the slope, the stones and boulders on the surface, the depth to bedrock, the high content of clay, and a moderate or high content of salt. It is poorly suited to native range grasses. The low or very low water-holding capacity results in low forage production in most years. North-facing slopes have greater potential for supporting plant growth than south-facing slopes since the north-facing slopes receive less direct sunlight. Overall production varies depending on the depth of the soil and annual rainfall. Rainwater runs off the surface rocks onto the adjacent soil, thus increasing the amount of water available to the adjacent soil. A planned grazing system that includes adequate deferment of grazing improves the quality and increases the quantity of desirable forage.

The natural vegetation provides food and cover for quail and rabbit. Scrubby mesquite provides good nesting and resting cover for dove in some areas. Turkey and possibly a few deer frequent areas that are adjacent to large river bottoms, but they do not inhabit

the areas because of a lack of protective cover.

This map unit is in capability subclass VIIs. The Latom soil is in the Very Shallow range site, and the Vernon soil is in the Shallow Clay range site.

Wc—Westfork silty clay, occasionally flooded. This soil is on the flood plains of the Trinity River and its tributaries. Flooding generally occurs about once every 7 or 8 years; however, some low areas and narrow areas that are 100 to 400 feet wide and are adjacent to smaller stream channels flood about twice each year. Slopes are generally less than 0.5 percent. Individual areas range from 450 to about 1,100 acres in size.

Typically, the surface layer is reddish brown silty clay about 16 inches thick. The upper 22 inches of the subsoil is dark brown clay that is calcareous below a depth of 21 inches. The lower 42 inches is reddish brown, calcareous clay.

This soil is well drained. Permeability is very slow, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Included with this soil in mapping are small areas of Grandfield soils on windblown ridges; small areas of Wichita soils on convex natural levees on the flood plain; narrow, frequently flooded sloughs; and small areas of Oil-waste land. Inclusions make up about 15 percent of this map unit.

All of the acreage of this soil is rangeland. Additional moisture, which is received in the form of runoff from adjacent slopes and occasional stream overflow, results in a moderately high or high production potential for mid grasses. Grazing when the soil is wet results in surface compaction and poor tilth. Brush control, reseeding, and a planned grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of the more desirable forage plants.

Several kinds of woody plants and seed-producing forbs and grasses provide fair cover, browse, mast, and seeds for songbirds, furbearers, game birds, and animals. Bands of trees and shrubs that are adjacent to creek channels are used as escape cover and travel lanes by coyote, deer, and turkey. Habitat quality can be improved through brush control and by selection of suitable plants. Grass and forb production is reduced by excessive grazing by wildlife. The grass provides nesting cover for quail and turkey.

Big bluestem, indiangrass, Johnsongrass, kleingrass, switchgrass, western wheatgrass, and tall wheatgrass are suitable pasture grasses. Weed control, a controlled grazing system, and timely application of fertilizer increase the quality and quantity of forage.

This soil is best suited to cool-season crops. Drought in the summer restricts yields of warm-season crops in most years. A hard crust forms on the surface after periods of rainfall. It impedes the emergence of germinating seed and reduces the rate of infiltration. The occasional flooding restricts plant growth, prevents germination, and can destroy entire crops if it occurs during critical growth stages. Leaving crop residue on the surface when crops are not being grown, applying minimum tillage in a timely manner, and using proper crop rotations help to control wind erosion and water erosion, minimize crusting, and conserve soil moisture. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years. Areas adjacent to river and creek channels and depressional areas that have a high potential for flooding should not be used as cropland.

This soil is poorly suited to most urban and recreational uses. The flooding, a high shrink-swell potential, and the very slow permeability are some of the limitations.

This map unit is in capability subclass IIIw and the Clayey Bottomland range site.

WdC—Weswind fine sandy loam, 1 to 5 percent slopes. This soil is mainly on gently sloping side slopes of ridges and divides and on foot slopes below receding escarpments in the uplands. Wind erosion and water erosion have thinned the surface layer in many areas, and small gullies and rills are common. Large, isolated gullies 5 to 15 feet wide and 2 to 5 feet deep are in about 30 percent of the mapped areas of the soil (fig. 16). Individual areas are elongated or irregular in shape and are convex. They range from 15 to 350 acres in size.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The upper 7 inches of the subsoil is reddish brown clay loam, the next 10 inches is reddish brown clay, and the lower 26 inches is clay mottled in shades of brown and red. The underlying material is partially weathered shale that has a clayey texture. It is mottled in shades of red, brown, and gray. Accumulations of calcium carbonate range from about 20 percent soft, powdery masses between depths of 48 and 65 inches to only a few at a depth of 80 inches.

This soil is moderately well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is medium or rapid. The hazards of wind erosion and water erosion are moderate.

Included with this soil in mapping are small areas of Aspermont and Vernon soils on eroded knolls and shoulder slopes, areas of Jolly soils and rock outcrop on ridge crests and shoulder slopes, and small areas of Oil-waste land. Inclusions make up about 20 percent of this map unit.

Figure 16.—A gully in an area of Weswind fine sandy loam, 1 to 5 percent slopes. The area is currently used as rangeland but was being used as cropland when the gully formed.

About 80 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for a few small areas that are in pasture or are used for nonagricultural purposes.

The climax plant community is mid prairie grasses. The quantity of desirable forage can be increased and the quality improved with a controlled grazing system, proper stocking rates, a deferred grazing system, and brush control.

The natural vegetation on this soil provides good cover and adequate food supplies for quail and rabbit. Scattered brush provides good nesting and resting protection for dove.

Suitable pasture plants include sideoats grama, several varieties of yellow bluestem, kleingrass, and weeping lovegrass. Brush and weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and improve the quality of desirable forage in most years.

A lack of adequate rainfall limits yields of cultivated crops in most years and especially limits yields of warm-season crops during the summer. Leaving residue on the surface when crops are not being grown, applying minimum tillage in a timely manner, using proper crop rotations, terracing, and farming on the contour help to control erosion and conserve moisture. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years.

The high content of clay, a high shrink-swell potential, the moderately slow permeability, and low

load-bearing strength are limitations affecting urban uses of this soil. The slope and the moderately slow permeability may restrict some recreational uses.

This map unit is in capability subclass IIIe and the Tight Sandy Loam range site.

We—Wheatwood silt loam, occasionally flooded. This soil is on flood plains along rivers and creeks. Flooding generally occurs about once every 6 years; however, some lower areas and some narrow areas that are 200 to 700 feet wide and are adjacent to smaller stream channels flood about twice each year. Slopes are 0 to 1 percent. Individual areas are long and narrow and parallel to stream channels. They range from 75 to about 800 acres in size.

Typically, the surface layer is reddish brown, calcareous silt loam about 6 inches thick. The subsoil to a depth of 34 inches is calcareous silt loam. It is reddish brown in the upper part and yellowish red in the lower part. The underlying material is stratified reddish brown, light reddish brown, and yellowish red, calcareous silty clay loam, silt loam, and very fine sandy loam. In some small areas the slope is as much as 2 percent.

This soil is well drained. Permeability is moderate, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Included with this soil in mapping are small areas of Mangum and Port soils in narrow sloughs, narrow areas that flood frequently, highly dissected gullied areas adjacent to some streambanks, and small areas of Oil-waste land. Inclusions make up about 20 percent of this map unit.

About 85 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland or pasture, except for a few small areas that are used for nonagricultural purposes.

Additional moisture, which is received in the form of runoff from adjacent slopes and occasional stream overflow, results in a moderately high or high production potential for native range grasses. The climax plant community consists of mid and tall grasses and many species of trees, shrubs, and forbs. The density of woody vegetation varies with the amount and frequency of extra water received. This soil responds well to brush control and reseeding. Proper stocking rates and a planned grazing system improve the quality and increase the quantity of desirable forage.

This soil provides good habitat for dove, quail, coyote, skunk, and squirrel throughout the county and for turkey and deer along the major creeks and rivers. Several kinds of woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and seed for songbirds, furbearers, game birds, and animals. Bands of trees and shrubs adjacent to creek channels are used as escape cover and travel lanes by deer, turkey, and coyote. Habitat quality can be improved through brush control and by selection of suitable plants. Grass and forb production is reduced by excessive grazing by livestock.

This soil is suited to cool-season small grain and warm-season crops. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain soil productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

Suitable pasture grasses include sideoats grama, Johnsongrass, kleingrass, and several varieties of yellow bluestem. Weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and improve the quality of forage.

The flooding limits the use of this soil for most urban and recreational development.

This map unit is in capability subclass IIw and the Loamy Bottomland range site.

WhA—Wichita clay loam, 0 to 1 percent slopes. This soil is on low, flat divides in the uplands and on low terraces. Individual areas are irregular in shape and have plane or convex surfaces. They range from 25 to about 140 acres in size.

Typically, the surface layer is dark brown, slightly alkaline clay loam about 8 inches thick. The subsoil is reddish brown and calcareous. It is clay loam in the upper 9 inches and clay in the lower 53 inches. The underlying material is interbedded reddish brown silty clay and light gray shale.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. The hazards of wind erosion and water erosion are slight.

Included with this soil in mapping are Hollister, Tillman, and Winters soils in landscape positions similar to those of the Wichita soil and small areas of Oil-waste land. Inclusions make up about 10 percent of this map unit.

About 85 percent of the acreage of this map unit is used as rangeland. The remaining acreage is used as cropland, except for a few small areas that are possibly seeded to pasture.

The climax plant community consists of short and mid grasses. This soil responds well to brush control and reseeding. Proper stocking rates and a controlled

grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of desirable forage.

This map unit provides habitat for openland wildlife including dove, quail, rabbit, and a few skunks, coyotes, or prairie dogs. A wide variety of natural vegetation provides protective nesting and resting cover and adequate food supplies.

A lack of adequate rainfall limits yields of cultivated crops in most years. This soil is best suited to cool-season small grain. A crust forms after periods of heavy rainfall if the soil is left unprotected. It decreases the rate of infiltration, increases the hazard of erosion, and impedes seed germination and seedling emergence. Using proper crop rotations, applying minimum tillage in a timely manner, and maintaining crop residue on the surface help to control erosion and conserve moisture. Crop residue management also helps to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer increases yields in most years.

Suitable pasture grasses include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. Brush and weed control, a controlled grazing system, and timely application of fertilizer improve the quantity of desirable forage in most years.

The moderately slow permeability, the high content of clay, low strength, and a moderate shrink-swell potential are limitations affecting urban development. This soil is well suited to recreational development.

This map unit is in capability subclass IIc and the Clay Loam range site.

WhB—Wichita clay loam, 1 to 3 percent slopes. This soil is on low divides and gently sloping side slopes. Individual areas are irregular in shape and are convex. They range from 25 to about 120 acres in size.

Typically, the surface layer is dark brown clay loam about 7 inches thick. The subsoil is reddish brown. It is calcareous clay in the upper 38 inches and calcareous silty clay in the lower 15 inches. The underlying material is interlayered, reddish brown silty clay and light gray shale.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is medium. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Aspermont and Vernon soils on the steeper side slopes and Grandfield, Tillman, and Winters soils on the slightly higher ridges and in landscape positions similar to those of the Wichita soil. Also included are small areas of Kamay soils and small areas of Oil-waste land. Inclusions make up about 10 percent of this map unit.

About 85 percent of the acreage of this map unit is rangeland. The remaining acreage is used as cropland, except for some small areas that have been seeded to pasture.

The climax plant community consists of short and mid grasses. This soil responds well to brush control and reseeding. Proper stocking rates and a controlled grazing system that includes adequate deferment of grazing increase the quantity and improve the quality of desirable forage.

The natural vegetation provides habitat for quail, dove, rabbit, and a few skunks or coyotes. A wide variety of grasses and scattered seed-bearing forbs furnish an adequate food supply in most years; however, seed production is reduced considerably in dry years. Areas of mesquite provide good nesting and resting cover for dove.

A lack of adequate rainfall limits the yields of cultivated crops in most years. This soil is best suited to cool-season small grain. A crust forms after periods of heavy rainfall if the surface is left unprotected. It decreases the rate of infiltration, increases the hazard of erosion, and impedes seed germination and seedling emergence. Leaving crop residue on the surface, applying minimum tillage in a timely manner, using proper crop rotations, terracing, and farming on the contour conserve moisture and help to control erosion. Crop residue management helps to maintain soil productivity and tilth and minimize crusting. Timely application of fertilizer increases yields in most years.

Suitable pasture grasses include sideoats grama, Johnsongrass, kleingrass, indiangrass, and several varieties of yellow bluestem. Weed and brush control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and improve the quality of forage in most years.

The moderately slow permeability, the high content of clay, low strength, and a moderate shrink-swell potential are limitations affecting urban development. This soil is well suited to recreational development.

This map unit is in capability subclass IIe and the Clay Loam range site.

WIC—Windthorst fine sandy loam, 1 to 5 percent slopes. This soil is on the gently sloping side slopes of ridges and divides and on foot slopes below receding escarpments on ancient stream terraces. It is in the southeastern part of the county in areas where post oak vegetation is dominant. Wind erosion and water erosion have thinned the surface layer in most areas, and small gullies and rills are common. Large, isolated gullies 5 to 15 feet wide and 2 to 5 feet deep are in about 30 percent of the mapped areas of this soil. Individual

areas are irregular in shape and are convex. They range from 25 to about 220 acres in size.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is clay loam in the upper 4 inches, sandy clay in the next 20 inches, and sandy clay loam in the lower 7 inches. It is reddish brown in the upper part and mottled reddish brown, brown, and red in the lower part. The underlying material is mottled in shades of brown, yellow, red, and gray. The upper 11 inches is sandy clay, and the lower part is sandy clay and shale.

This soil is moderately well drained. Permeability is moderately slow, and available water capacity is moderate. Surface runoff is medium or rapid. The hazards of wind erosion and water erosion are moderate.

Included with this soil in mapping are small areas of Bonti soils on ridge crests; areas of Vernon soils on the steeper, eroded side slopes; areas where sandstone outcrops in bands on shoulder slopes; and small areas of Oil-waste land. Inclusions make up about 20 percent of this map unit.

Most of the acreage of this soil is rangeland (fig. 17). The climax plant community is a post oak savanna with a mid and tall grass understory. The quantity of forage can be increased and the quality improved with a controlled grazing system, adequate deferment of grazing, and control of undesirable brush.

The natural vegetation on this soil provides good cover and adequate food supplies for deer, dove, quail, squirrel, and turkey. Many of the woody plants, forbs, and grasses that grow on this soil provide good cover, browse, mast, and seed for game birds and animals.

A lack of adequate rainfall limits yields of cultivated crops in most years. This soil is best suited to cool-season small grain. Leaving residue on the surface when crops are not being grown, applying minimum tillage in a timely manner, using proper crop rotations, terracing, and farming on the contour help to control erosion and conserve moisture. Crop residue management helps to maintain soil productivity and tilth. Timely application of fertilizer increases yields in most years.

Suitable pasture grasses include sideoats grama, several varieties of yellow bluestem, kleingrass, and weeping lovegrass. Brush and weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and improve the quality of desirable forage in most years.

The high content of clay, a high shrink-swell potential, and low load-bearing strength are limitations affecting urban uses. The slope may restrict some recreational uses.

This map unit is in capability subclass IIIe and the Tight Sandy Loam range site.

WnA—Winters loam, 0 to 1 percent slopes. This soil is on ancient stream terraces that have plane or slightly convex surfaces. Individual areas are irregular in shape. They range from 15 to about 3,200 acres in size.

Typically, the surface layer is brown loam about 11 inches thick. The subsoil is reddish brown clay in the upper 10 inches, yellowish red clay in the next 9 inches, and yellowish red clay loam in the lower 38 inches. Accumulations of calcium carbonate are below a depth of 30 inches. The underlying material is stratified yellowish red and reddish yellow sandy clay loam.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Included with this soil in mapping are areas of Wichita and Deandale soils in landscape positions similar to those of the Winters soil and small areas of Oil-waste land. Inclusions make up about 15 percent of this map unit.

About 50 percent of the acreage of this map unit is used as cropland. The remaining acreage is rangeland, except for a few small areas that have been seeded to pasture grasses and a few areas that are used for nonagricultural purposes.

Small grain, cotton, and forage sorghum are the main crops grown on this soil. Drought in the summer limits yields in some years. Using proper crop rotations, applying minimum tillage in a timely manner, and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years.

The best suited pasture grasses include sideoats grama, Johnsongrass, kleingrass, bermudagrass, and several varieties of yellow bluestem. Weed control, a controlled grazing system that includes adequate deferment of grazing, and timely application of fertilizer increase the quantity and improve the quality of forage.

The climax plant community is mid prairie grasses. This soil responds favorably to brush control and reseeding. A controlled grazing system that includes adequate deferment of grazing increases the quality and quantity of forage.

This map unit provides good habitat for dove, quail, coyote, rabbit, and skunk. A wide variety of vegetation furnishes a good supply of food as well as protective nesting and resting cover.

The moderately slow permeability, low strength, the high content of clay, and moderate shrink-swell

Figure 17.—Native range in an area of Windthorst fine sandy loam, 1 to 5 percent slopes.

potential are limitations affecting urban development. This soil is well suited to recreational uses.

This map unit is in capability subclass IIc and the Clay Loam range site.

WnB—Winters loam, 1 to 3 percent slopes. This soil is on ancient stream terraces along most of the major streams in the county. Individual areas are narrow and elongated and are convex. They range from 15 to 220 acres in size.

Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil is reddish brown clay in the upper 10 inches, red clay in the next 33 inches, and reddish brown clay loam in the lower 46 inches. Accumulations of calcium carbonate are below a depth of 30 inches.

This soil is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is medium. The hazards of wind erosion and water erosion are moderate.

Included with this soil in mapping are small areas of Aspermont soils on shoulder slopes, areas of Deandale soils in landscape positions similar to those of the Winters soil, and small areas of Oil-waste land. Inclusions make up about 5 percent of this map unit.

About 50 percent of the acreage of this map unit is used as cropland. The remaining acreage is rangeland, except for a few small areas that are used for nonagricultural purposes.

Small grain, cotton, and forage sorghum are the main crops. Drought in the summer limits yields in some years. Terracing, contour farming, using proper crop rotations, and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain productivity and tilth. Cultivation should be timely and limited. Timely application of fertilizer increases yields in most years.

Suitable pasture grasses are sideoats grama, Johnsongrass, kleingrass, and several varieties of yellow bluestem. Weed and brush control, a controlled grazing system, and timely application of fertilizer help to maintain productivity.

The climax plant community is mid prairie grasses. This soil responds favorably to brush control and reseeding. A controlled grazing system that includes adequate deferment of grazing increases the quality and quantity of desirable forage.

Dove, quail, rabbit, coyote, skunk, and badger inhabit areas of this map unit. Several of the woody plants, forbs, and grasses growing naturally on this soil provide a good supply of food and protective nesting and resting cover. Deer and turkey are in areas along major drainageways, which provide abundant brush for supplemental grazing and afford escape cover and travel lanes.

The moderately slow permeability, low strength, the high content of clay in the subsoil, and moderate shrink-swell potential are limitations affecting urban development. Proper design and careful installation can help to overcome these limitations. This soil is well suited to recreational uses.

This map unit is in capability subclass IIe and the Clay Loam range site.

Yo—Yomont very fine sandy loam, occasionally flooded. This soil is on flood plains along rivers and large creeks. Flooding generally occurs once every 15 to 20 years; however, some narrow areas that are 100 to 300 feet wide and are remnants of ancient stream channels and a few smaller flood plains flood once every 1 to 3 years. Slopes range from 0.5 to 1.5 percent. Individual areas range from 60 to about 280 acres in size.

Typically, the surface layer is reddish brown very fine sandy loam about 9 inches thick. The underlying material is stratified very fine sandy loam, fine sandy loam, and loamy very fine sand. It is reddish brown in the upper part and grades to yellowish red in the lower part. This soil is calcareous throughout.

This soil is well drained. Permeability is moderately rapid, and available water capacity is high. Surface runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

Included with this soil in mapping are narrow bands of Wheatwood soils in concave sloughs and areas of soils that are similar to the Yomont soil but are fine sandy loam. Also included are narrow areas of more sloping soils on benches and short escarpments that divide the flood plain into different levels. Inclusions make up about 20 percent of this map unit.

Most of the acreage of this soil is rangeland. Native vegetation is tall prairie grasses and scattered trees, shrubs, and forbs. Additional moisture, which is received in the form of runoff from adjacent slopes and occasional stream overflow, increases the production potential. The density of trees and shrubs varies with the amount of extra water received. Brush control, reseeding, and a planned grazing system that includes adequate deferment of grazing improve the quality and increase the quantity of desirable forage.

Quail, dove, coyote, turkey, raccoon, skunk, opossum, assorted songbirds, and a few deer are native to this map unit. Several of the woody plants and seed-producing forbs and grasses provide good cover, browse, mast, and food supplies. Bands of trees and shrubs adjacent to creek channels are used as escape cover and travel lanes. Grass and forb production is reduced by excessive grazing by livestock.

Suitable pasture grasses include bermudagrass, sand bluestem, big bluestem, sideoats grama, indiangrass, Johnsongrass, kleingrass, weeping lovegrass, blue panicum, switchgrass, and western wheatgrass. Weed and brush control, a controlled grazing system, and timely application of fertilizer improve the quality and increase the quantity of forage.

Leaving crop residue on the surface, applying minimum tillage in a timely manner, and using proper crop rotations help to control wind erosion and conserve moisture when this soil is used as cropland. Crop residue management also helps to maintain soil productivity and tilth. Timely application of fertilizer according to soil tests increases yields in most years. The narrow, low areas that have a high potential for flooding should not be cropped.

The flooding restricts the use of this soil for most urban and some recreational uses.

This map unit is in capability subclass IIw and the Loamy Bottomland range site.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, State, and Federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. The moisture supply must be adequate, and the growing season must be sufficiently long. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They are used for food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming in National forests, National parks, military reservations, and State parks.

Prime farmland soils usually receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not frequently flooded during the growing season. The slope ranges mainly from 0 to 5 percent.

About 49 percent of the total acreage of Archer County meets the soil requirements for prime farmland. An additional 19 percent meets the requirements if the soils are irrigated. Prime farmland soils are common throughout the county except in areas of general soil map unit 3 where very little acreage meets the requirements for prime farmland. About 70 percent of the prime farmland is used as rangeland.

The soils that make up prime farmland in Archer County are listed in table 5. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Soils that receive an inadequate amount of rainfall qualify as prime farmland only in areas where this limitation has been overcome by irrigation. The need for irrigation is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not a specific area is irrigated.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified and the system of land capability classification used by the Soil Conservation Service is explained. The estimated yields of the main crops and hay are listed for each soil in table 6.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 94,270 acres, or nearly 16 percent of the county, is used as cropland. The main crops are wheat, cotton, and forage sorghum. Oats, barley, rye, vetch, grain sorghum, alfalfa, pecans, melons, and millet also are grown. Grass and legume seed are sometimes produced from kleingrass, switchgrass, alfalfa, vetch, weeping lovegrass, and introduced bluestems.

The soils and climate of the county are suited to some field crops that are not commonly grown in the county. These crops include peanuts, guar, corn, sunflowers, castor beans, and mung beans. These crops and similar crops can be grown if economic conditions are favorable.

The very deep, loamy, and well drained Grandfield soil is especially suited to truck crops in areas where the slope is less than 3 percent. It also is suited to fruit, vineyards, and nursery plants. Production is limited mainly by the amount of rainfall received or the availability of irrigation water.

The very deep, loamy soils on flood plains are usually poorly suited to truck crops and other horticultural crops because of the danger of flooding and the concentration of cold air.

The potential of the soils for increased production of food and fiber is good in Archer County. More than 300,000 acres of soils that have good potential for cropland is currently used as rangeland. In addition to the reserve production capacity represented by this acreage, food and fiber production could be increased considerably by applying the latest crop production technology to all of the cropland in the county. Information provided in this soil survey can greatly facilitate the application of such technology.

Management concerns in areas of cropland are erosion control, soil fertility and tilth, and soil moisture. Some climatic factors that limit crop production are flooding, high winds, and occasional hailstorms and high-intensity rainfall.

Erosion Control

Water erosion is a major concern in nearly all of the large areas of cropland and in the smaller areas of cropland that have a slope of more than 1 percent. It reduces productivity, especially when the surface layer is so eroded that it is mixed with the less fertile subsoil during cultivation. The subsoil is low in organic matter, and in some places it contains undesirable salts. When mixed with topsoil it causes a dense crust to form on the surface. This crust reduces the rate of infiltration and hinders the emergence of seedlings.

Erosion is especially damaging on soils that are moderately deep over bedrock, such as the Bluegrove, Bonti, Rowden, and Vernon soils. As erosion reduces the thickness of these soils, their root zone becomes more restricted and their ability to store moisture is reduced.

Soil loss by water erosion results in sedimentation of streams, ponds, and lakes. Control of erosion minimizes sedimentation and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Cropping systems should be designed so that they hold soil losses by erosion to a minimal amount in order for productive capacity to be maintained indefinitely. Farming practices that help to control water erosion are those that provide a protective surface cover, reduce the amount and rate of runoff, and increase the rate of water infiltration.

Crop residue management is the best method to help control erosion. It also helps to control runoff. Reduced tillage systems that leave a maximum amount of crop residue on the surface provide the protective cover needed. Delaying seedbed preparation for as long as possible extends the length of time that residue is on the surface. Protecting residue from grazing and burning is necessary for maximum effectiveness.

Terraces and diversions help to control erosion by reducing the length of slope and thus slowing runoff. They also serve as guidelines for contour farming. Nearly all of the cropland in the county is suited to terraces. Terracing and contour farming increase the rate of water infiltration, thereby increasing crop yields when moisture is limited. Establishing protective grassed waterways to remove excess runoff from terraces and diversions is essential to prevent the formation of gullies.

Wind erosion is a hazard on the loamy Bluegrove, Bonti, Deandale, Grandfield, Kamay, Weswind, Windthorst, Winters, and Yomont soils during periods of drought and during windstorms that occur in winter and spring.

Some crops, such as cotton, do not produce an adequate amount of residue to help control wind erosion during cool-season periods. Rotation of cotton with wheat and sorghum increases the amount of residue left on the surface. Soils that are left bare and smooth can be damaged in a few hours if the wind is strong. Maintaining a vegetative cover and keeping a bare surface rough by tillage also help to control wind erosion. Cover crops commonly used during cool-season periods include alfalfa, austrian winter peas, and vetch. These legumes protect the soil from wind erosion and water erosion, provide high-quality grazing, and add nitrogen to the soils.

More specific information on erosion-control measures for each kind of soil can be obtained at the local office of the Soil Conservation Service.

Soil Fertility and Tilth

Fertility is naturally high in most of the soils on flood plains, such as the Mangum, Port, and Wheatwood soils. Many of the dark soils on uplands, such as the Deandale, Hollister, Rotan, Rowden, and Tillman soils, also are high in natural fertility. The light colored, fine sandy loam soils on uplands are medium in natural fertility. They include the Bluegrove, Bonti, Grandfield, Weswind, and Windthorst soils. Most of the soils in the county benefit from the addition of nitrogen, phosphorus, and potassium. Calcareous soils on the flood plains, however, are usually high in potassium. Many areas of the Bonti soils are low in calcium and may benefit from the addition of lime. On all soils the amount and type of fertilizer should be based on the results of soil tests, the needs of the crop, the expected level of yields, the previous land use or cropping sequence, and the amount of available soil moisture. The Texas Agricultural Extension Service can furnish the latest information on the kinds and amounts of fertilizer to apply and can provide assistance in obtaining soil tests.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular, porous, and friable. Tilth can be improved by adding large amounts of organic matter, leaving crop residue on or near the surface, and reducing the number of tillage operations. Fine textured soils, such as Hollister, Rotan, Rowden, Tillman, Vernon, and Wichita soils, tend to have moderate amounts of organic matter and good structure. They tend to be cloddy, however, if plowed when they are too wet or too dry. Preparing a good seedbed is difficult in a cloddy soil. Plowing when the

soil is wet also causes dense plowpans to develop. Grazing when the soil is wet severely damages soil structure and causes a dense crust to form. Both of these conditions restrict the downward movement of air and water and the growth of roots and cause the rate of runoff to increase. Fall plowing results in good tilth in spring, but wind erosion and water erosion usually occur if the soil is left bare of vegetation.

Soils that have a light colored surface layer of fine sandy loam, loam, or silt loam usually have a low content of organic matter. Some of these soils have a clayey subsoil and may contain concentrations of undesirable salts in or near the surface layer. Generally, the structure of these soils is poor and a thick surface crust tends to form after periods of intense rainfall. Once it forms, the crust reduces the rate of infiltration and increases the rate of runoff. Emerging plant seedlings are often unable to penetrate the thick crust. Regularly adding crop residue, manure, and cotton burs or other organic material to the soil and growing legumes improve soil structure and soil tilth and minimize the formation of crusts. In areas where salts are near the surface, the depth of tillage should be limited so harmful salts will not be concentrated within the plow layer.

Soil Moisture

Inadequate soil moisture is the most limiting factor for crop production in the county. Although average yearly rainfall is generally adequate for most crops, short periods of drought are common during the growing season. In some years droughts last longer than 3 months. The most severe conditions usually occur during mid to late June when dry, hot air from the southwest replaces humid airflow from the south and southeast. As temperatures reach or exceed 100 degrees F, crops begin to wilt. The wilting is more severe on Deandale, Hollister, Kamay, Tillman, and Winters soils than on other soils in the county. Although these soils are very deep and have a high available water capacity, they also have a clayey subsoil with poor structure. The subsoil restricts the movement of water to roots and makes it difficult for the roots to penetrate the soil. Under these conditions crops do not receive all of the water needed for growth. Also, some of these soils have a high content of salt that further reduces moisture availability to plants.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit *(10)*. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce

the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode, but they have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

There are no subclasses in class I because the soils of this class have few limitations. The soils in class V are subject to little or no erosion, but they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation. Class V contains only the subclasses indicated by *w, s,* or *c.*

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Rangeland

Dan Caudle, state range conservationist, Soil Conservation Service, helped prepare this section.

In areas of rangeland the native vegetation is predominantly grasses, forbs, and shrubs that are suitable for grazing and browsing by livestock and wildlife. Rangeland is not regularly treated with intensive cultural practices such as fertilization or tillage. The plant composition is extremely varied and is strongly influenced by soil, climate, topography, overstory canopy, and grazing management.

Rangeland is the primary land use on 475,960 acres, or 82 percent of the land area in the county. It varies from open, treeless bluestem prairie to post oak savanna. The original plant community has deteriorated on much of the rangeland in the county over the last 100 years. Continuous heavy grazing by cattle is the primary reason for this deterioration. Tall grasses are now found only in plant communities that are properly managed. These remnant populations of the original plant species are evidence of the potential that these areas have when grazing management is practiced.

Livestock operations on rangeland in the county consist primarily of cow-calf operations, but some stocker operations are carried out where supplemental grazing from wheat is available. Kleingrass, an introduced grass, is commonly established to furnish high-quality supplemental grazing.

Approximately 75 percent of the annual production of forage is grown from April through June when spring rains and moderate temperatures are most favorable for plant growth. A secondary growth period occurs in September and October when fall rains and gradually cooling temperatures are common.

Short-term, seasonal droughts occur most summers and may last for several weeks at a time. Devastating, long-term droughts, which may last for several months to as long as a few years, occur periodically in a 10- to 20-year cycle.

Range Sites and Condition Classes

Different kinds of soil vary in their ability to produce grass and other plants for grazing. Soils that produce about the same kinds, amounts, and proportions of forage make up a range site.

Climax vegetation on the range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing there when the region was first settled. This plant community reproduces itself and changes very little as long as the environment remains unchanged. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount with continuous heavy grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are plants that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that are not able to compete with other plants in the climax plant community for moisture, nutrients, and light. However, they grow along with increasers after the climax vegetation has been reduced

by grazing. Most invaders have little value for grazing.

Range condition is judged according to the standards that apply to a particular range site. It expresses the present plant community and the kind and amount of vegetation in relation to the climax plant community for that site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation. The classes show the present condition of the native vegetation on a range site compared to the native vegetation that could grow there. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during the growing season.

A primary objective of range management is to keep range in excellent or good condition. If the range is well managed, water is conserved, yields are improved, and the soils are protected. The main management concern is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Plant growth that occurs because of heavy rainfall can lead to the conclusion that the range is in good condition when the plant community actually has a large percentage of weeds and the long-term trend is toward lower production. Conversely, some rangeland that has been closely grazed for short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and ability to recover.

If range is subject to years of prolonged overuse, it loses the sources of seeds of desirable vegetation. Under these conditions, the vegetation must be reestablished before management can be effective. Brush control, range seeding, fences, development of water sites, or other mechanical treatment revitalizes the stands of native plants. Thereafter, deferred grazing, proper grazing use, and a planned grazing system help to maintain and improve the range.

Good management generally results in optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Table 7 shows, for nearly all soils, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as or are suited to rangeland are listed. An explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table also are important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

There are 13 range sites in the county. A brief description of each follows:

Clayey Bottomland range site. The Mangum and Westfork soils in detailed soil map units Ma, Mc, Mw, and Wc are in this range site. These nearly level, very slowly permeable soils are on flood plains. They are highly fertile, but plant growth is restricted by the clayey texture of the soils. Small areas of scalded saline soils are in the range site.

The climax plant community is short and mid grasses. Buffalograss and blue grama are the dominant grasses. Other important grasses are vine-mesquite, Arizona cottontop, sideoats grama, white tridens, and alkali sacaton. Heath aster, Maximilian sunflower, Illinois bundleflower, and other forbs are in scattered areas. Trees and shrubs native to the site include elm, hackberry, bumelia, western soapberry, and greenbriar.

The original plant community has deteriorated in most areas of this range site because of overgrazing, flooding, and other adverse conditions. As deterioration occurs, buffalograss totally dominates the site and threeawns and annual grasses replace the more desirable mid grasses. Western ragweed and annual forbs replace the desirable perennial forbs. Mesquite

and pricklypear invade the site, and underbrush along the creek becomes dense. Natural vegetative improvement is extremely slow because of the dense structure of the soils and the clayey texture.

Clay Loam range site. The Aspermont, Hollister, Rotan, Rowden, Tillman, Wichita, and Winters soils in detailed soil map units AsC3, HoA, HoB, RoA, RoB, RwB, TcA, TcB, WhA, WhB, WnA, and WnB are in this range site. These nearly level to gently sloping, moderately permeable to very slowly permeable soils are on uplands. They are droughty during the summer, and crusting can become a problem as vegetation deteriorates. Small areas of salt are common in the range site.

The climax plant community is dominantly mid grasses. Sideoats grama and vine-mesquite are the dominant grasses with a lesser amount of buffalograss. Other important grasses are Arizona cottontop and western wheatgrass. Forbs, such as Engelmann daisy, heath aster, and gayfeather, also are present. Woody vegetation is sparse in areas of the range site. Ephedra, sensitive briar, and lotebush are occasionally present.

As overgrazing and adverse conditions occur, the vegetation on this range site deteriorates. As deterioration occurs, the amount of buffalograss increases to the point that it dominates the range site. Threeawn and annual grasses, such as Japanese brome, replace desirable perennial grasses. Annual forbs, such as broomweed, replace the native forbs. Mesquite and pricklypear invade the site, and the amount of lotebush increases drastically.

Claypan Prairie range site. The Deandale and Kamay soils in detailed soil map units DeA, DeB, DnA, DnB, DsA, KaA, KaB are in this range site. These nearly level to gently sloping, slowly permeable or very slowly permeable soils are on uplands. The blocky, clayey subsoil of these soils inhibits plant growth and restricts the movement of water. As a result, the range site is droughty. Small areas of salt are common on the site.

The climax plant community is mid grasses. Vine-mesquite, sideoats grama, blue grama, and Arizona cottontop are the dominant grasses with lesser amounts of buffalograss and Texas winter-grass. Heath aster, gayfeather, Engelmann daisy, sagewort, and other forbs are in scattered areas. Low-growing woody vegetation is in sparse areas and includes ephedra, lotebush, and sensitive briar.

Overgrazing on this range site results in an increase of buffalograss and Texas winter-grass and a decrease in sideoats grama and vine-mesquite. Further deterioration leads to an invasion of mesquite, lotebush, pricklypear, hairy tridens, tumble lovegrass, Japanese brome, and broomweed.

Draw range site. The Port soils in detailed soil map units Po and Pw are in this range site. These nearly level, moderately permeable soils are on flood plains. Additional moisture is received in the form of runoff from adjacent slopes and stream overflow.

The climax plant community is mid grasses. Sideoats grama, vine-mesquite, western wheatgrass, and Texas winter-grass are the dominant grasses. A wide variety of forbs, including Maximilian sunflower, Engelmann daisy, bundleflower, heath aster, and gayfeather, also is present. A significant number of trees and shrubs, such as elm, hackberry, bumelia, and western soapberry, are in areas of the range site.

If the vegetation is subjected to continuous heavy grazing and adverse conditions, the preferred grasses are gradually replaced by buffalograss, meadow dropseed, and Texas winter-grass (fig. 18). Continued deterioration leads to domination by buffalograss and an invasion of mesquite, pricklypear, and western ragweed.

Loamy Bottomland range site. The Wheatwood and Yomont soils in detailed soil map units Mw, Po, Pw, We, and Yo are in this range site. These nearly level, moderately rapidly permeable or moderately permeable soils are on flood plains. They receive additional moisture in the form of runoff from adjacent slopes and stream overflow and may also have a high water table. They are very deep and fertile. Frequent, severe flooding causes damaging deposition of silt and debris that may result in abrupt changes in vegetation composition.

The climax plant community is dominantly tall grasses with a wide variety of trees, shrubs, and forbs. The dominant grasses are indiangrass, sand bluestem, and switchgrass. Other important grasses include western wheatgrass, sideoats grama, little bluestem, plains bristlegrass, Canada wildrye, vine-mesquite, and Texas winter-grass. The dominant forbs are Maximilian sunflower, Engelmann daisy, heath aster, and bundleflower. Native trees and shrubs include pecan, oak, elm, cottonwood, hackberry, bumelia, Osage-orange, redbud, and grape.

If this range site is overgrazed, flooded, or otherwise adversely affected, the tall grasses are replaced by Texas winter-grass, buffalograss, threeawns, and sand dropseed. If deterioration continues, buffalograss, Texas winter-grass, threeawns, western ragweed, annual grasses, and annual forbs dominate the range site.

Figure 18.—The effect of overgrazing shown in this area of the Draw range site. The area that now supports short grasses has been overgrazed.

Saline range site. The Deandale and Kamay soils in detailed soil map unit KDA are in this range site.

The original plant community consisted primarily of mid grasses, such as vine-mesquite, sideoats grama, blue grama, buffalograss, and Texas winter-grass. As the content of salt in the soils increased, the composition of the community changed drastically. Currently, the dominant species are alkali sacaton, fall witchgrass, Indian rushpea, sand dropseed, seep muhly, Texas dropseed, tumble windmillgrass, and whorled dropseed. Production varies greatly depending upon the concentration of salt.

Sandstone Hill range site. The Darnell, Exray, and Jolly soils in detailed soil map units DaD and JoC are in this range site. These shallow, very gently sloping to moderately steep soils are moderately rapidly permeable to moderately slowly permeable. They are underlain by sandstone. Sandstone fragments cover 10 to 30 percent of the surface. Vegetation is strongly influenced by the slope. North-facing slopes have greater potential for supporting plant growth than south-facing slopes since the north-facing slopes receive less direct sunlight.

The climax plant community is tall and mid grasses with many trees and a good variety of forbs. Little bluestem is the dominant grass with lesser amounts of indiangrass, sand bluestem, and sideoats grama. Post oak and blackjack oak make up a significant part of the native vegetation, especially in the southeastern part of the county. A good variety of perennial forbs also is present.

If this range site is overgrazed or otherwise adversely affected, the tall grasses are replaced by little bluestem and sideoats grama. If deterioration continues, silver bluestem, hairy grama, and skunkbush sumac increase in abundance. In the later stages of degeneration, the site is invaded by threeawns, red lovegrass, sand dropseed, ragweed, silverleaf nightshade, elm, greenbriar, mesquite, and juniper.

Sandy Bottomland range site. The Gracemore soil in detailed soil map unit Gm is in this range site. This nearly level, rapidly permeable or moderately rapidly permeable soil is on flood plains. Frequent, severe flooding may cause abrupt changes in vegetation. Areas of salt are scattered throughout the range site.

The climax plant community is tall grasses with a good variety of forbs and scattered trees and shrubs. The dominant grasses are switchgrass, sand bluestem, and indiangrass. Little bluestem and western wheatgrass are other important grasses. Partridge pea, western indigo, Maximilian sunflower, and other forbs are present. The dominant woody species include cottonwood, plum, bumelia, hackberry, and western soapberry.

If this range site is overgrazed, flooded, or otherwise adversely affected, the tall grasses are replaced by alkali sacaton, inland saltgrass, seep muhly, and buffalograss. If deterioration continues, the site is invaded by baccharis, saltcedar, and mesquite, which form dense brush thickets.

Sandy Loam range site. The Bonti and Grandfield soils in detailed soil map units BtC and GrC are in this range site. These nearly level to gently sloping, moderately permeable soils are on uplands.

The climax plant community is mid and tall grasses with an abundance of perennial forbs. Little bluestem is the dominant grass with significant amounts of sand bluestem, indiangrass, and sideoats grama. Major forbs include Engelmann daisy, bush sunflower, bundleflower, gayfeather, dalea, and prairie clover.

If this range site is overgrazed or otherwise adversely affected, the tall and mid grasses are replaced by silver bluestem, hooded windmillgrass, and hairy grama and the amount of skunkbush sumac increases. If deterioration continues, threeawns, sand dropseed, red lovegrass, western ragweed, and silverleaf nightshade invade the site. Mesquite, juniper, and greenbriar dominate the site in areas where the range site is in very poor condition.

Shallow Clay range site. The Vernon soils in detailed soil map units KvD, KvE, VeC, VkD, and VlD are in this range site. These nearly level to strongly sloping, very slowly permeable soils are on uplands. Surface crusting and the hazard of erosion are management concerns if vegetation is removed.

The climax plant community is short and mid grasses with a wide variety of perennial forbs and scattered shrubs. Sideoats grama and silver bluestem are the dominant grasses. Buffalograss, curlymesquite, slim tridens, rough tridens, and meadow dropseed are other important grasses. Little bluestem is in areas where the soil and moisture conditions are favorable. Skullcap, verbena, Indian rushpea, plains blackfoot, and other forbs also are present. The dominant shrubs are ephedra, yucca, agarito, catclaw acacia, lotebush, black dalea, fourwing saltbush, and shadscale.

If this range site is overgrazed or otherwise adversely affected, the sideoats grama is replaced by buffalograss, silver bluestem, hairy grama, threeawns, and tumblegrass. If deterioration continues, these species are replaced by Texas grama, sand muhly, and undesirable brush species, such as mesquite, juniper, lotebush, and pricklypear. Areas of bare ground are extensive on the range site, especially if the plant community is in the later stages of succession.

Tight Sandy Loam range site. The Bluegrove, Weswind, and Windthorst soils in detailed soil map units BeB, WdC, and WlC are in this range site. These nearly level to gently sloping soils are moderately slowly permeable.

The climax plant community is mid prairie grasses. Sideoats grama is the dominant grass. Other important grasses include blue grama, vine-mesquite, Arizona cottontop, and little bluestem. Heath aster, gayfeather, and other forbs are in scattered areas. Native post oak trees are in areas of the Windthorst soils but are not in areas of the Bluegrove and Weswind soils.

If this range site is overgrazed or otherwise adversely affected, the original plant community is replaced gradually by less desirable species, such as buffalograss, silver bluestem, sand dropseed, western ragweed, and yucca. Continued overgrazing causes additional degradation of the plant community and results in an invasion of low-quality plant species, such as mesquite, pricklypear, lotebush, threeawns, Texas grama, and hairy tridens.

Very Shallow range site. The Latom soil in detailed soil map unit VlD is in this range site. This nearly level to strongly sloping, moderately permeable soil is very shallow. It has numerous small rocks, gravel, or caliche on the surface and throughout the soil profile. Sandstone bedrock is at the surface or in the profile in some areas.

The climax plant community is short and mid grasses

with a small amount of tall grasses, a wide variety of forbs, and scattered shrubs and trees. Sideoats grama and little bluestem are the dominant grasses. Primary perennial forbs include plains blackfoot, gayfeather, trailing ratany, skullcap, gray goldaster, and twoleaf senna. Hackberry, sumac, catclaw acacia, and agarito are the major trees and shrubs.

If this range site is overgrazed or otherwise adversely affected, the preferred grasses and forbs are replaced by Texas grama, hairy tridens, red grama, threeawn, croton, and ragweed. If deterioration continues, the site is invaded by catclaw acacia, juniper, and a limited amount of mesquite.

Very Shallow Clay range site. The Knoco soils in detailed soil map units KvD, KvE, and VkD are in this range site. These nearly level to moderately steep soils are very slowly permeable. They are very shallow over Permian red beds or shale and have calcareous, clayey surfaces. The range site occurs as extensive bare areas intermingled with areas that have pockets of vegetation on rough, broken terrain. Surface crusting and the hazard of erosion are severe limitations if vegetation is removed.

The climax plant community is short and mid grasses with scattered perennial forbs and a few low-growing shrubs. Sideoats grama is the dominant grass along with buffalograss, curlymesquite, alkali sacaton, silver bluestem, and hairy grama. Plains blackfoot, Indian rushpea, gayfeather, and sensitive briar are the primary forbs. The dominant shrubs are lotebush, ephedra, fourwing saltbush, and shadscale.

If this range site is overgrazed or otherwise adversely affected, the sideoats grama is replaced by buffalograss and curlymesquite. If deterioration continues, these species are replaced by threeawn, Texas grama, sand muhly, and undesirable brush species, such as mesquite, juniper, lotebush, pricklypear, and tasajillo. Areas of bare ground are extensive on the range site, especially if the plant community is in the later stages of succession.

Recreation

In table 8, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Off-road motorcycle trails require little or no preparation. They are not vegetated or surfaced. Considerable soil compaction on the trail is expected. The best soils are not wet, are firm after periods of rainfall, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

The nongame species of wildlife in Archer County include numerous songbirds, herons, raptors, small furbearing animals, and armadillo. Small game species are bobwhite quail, mourning dove, cottontail rabbit, jackrabbit, and squirrel, and big game species include large furbearing animals, white-tailed deer, and turkey. Ducks and geese rest and feed on lakes and ponds and in grain fields. The most common furbearers are raccoon, coyote, red fox, and bobcat. A few beaver, mink, and muskrat are found along the major streams.

Hardwood trees located along perennial and intermittent streams, draws, and escarpments provide food supplies, nesting and roosting sites, travel lanes, and escape cover for wildlife throughout the county.

Sport fishing is limited to public and private lakes and to farm ponds. Most fish are warm-water species, such as black bass, channel catfish, sunfish, crappie, white bass, carp, flathead catfish, bullheads, and shad.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and sunflowers.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are bumelia, hawthorn, skunkbush sumac, lotebush, greenbrier, and plum.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, turkey, dove, meadowlark, field sparrow, cottontail, and red fox (fig. 19).

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include rabbit, deer, wild turkey, meadowlark, and bobwhite quail.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is

Figure 19.—Wildlife habitat can be improved by planting desirable seed-producing plants. This stand of sunflowers will attract numerous dove and quail.

affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. Depth to a high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, depth to a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and

depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, depth to a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, depth to a water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly

organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and

fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and releases a variety of plant nutrients as it decomposes.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for terraces and diversions and for grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 20.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 20.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-

weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence the shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very

high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate

(high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year). *Frequent* means that flooding occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Physical, Chemical, and Mineralogical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 17, the results of chemical analysis in table 18, and the results of mineralogical analysis in table 19. The data are for soils sampled at carefully selected sites. The pedons are representative of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the Soil Survey Laboratory Staff.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an ovendry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(12)*.

Sand—(0.05-2.0 mm fraction) weight percentages of material less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all material less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction,

weight percentages of material less than 2 mm (3A1).
Water retained—pressure extraction, percentage of ovendry weight of less than 2 mm material; ⅓ or 1/10 bar (4B1), 15 bars (4B2).
Water-retention difference—between ⅓ bar and 15 bars for whole soil (4C1).
Bulk density—of less than 2 mm material, saran-coated clods field moist (4A1a), ⅓ bar (4A1d), ovendry (4A1h).
Linear extensibility—change in clod dimension based on whole soil (4D).
Organic carbon—wet combustion. Walkley-Black modified acid-dichromate, ferric sulfate titration (6A1c).
Extractable cations—ammonium acetate pH 7.0, atomic absorption; calcium (6N2e), magnesium (6O2d), sodium (6P2b), potassium (6Q2b).
Extractable acidity—barium chloride-triethanolamine IV (6H5a).
Cation-exchange capacity—ammonium acetate, pH 7.0, steam distillation (5A8b).
Base saturation—sum of cations, TEA, pH 8.2 (5C3).
Reaction (pH)—1:1 water dilution (8C1f).
Carbonate as calcium carbonate—(fraction less than 2 mm) manometric (6E1g).
Electrical conductivity—saturation extract (8A3a).
Sodium adsorption ratio (5E).
Exchangeable sodium percentage—ammonium acetate, pH 7.0 (5D2).
X-ray diffraction (7A2).
Differential thermal analysis (7A3).

Engineering Index Test Data

Table 20 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Specific gravity—T 100 (AASHTO), D 854 (ASTM); and Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(11)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustalf (*Ust*, meaning limited moisture, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Paleustalfs (*Pale*, meaning extensive horizonation, plus *ustalf*, the suborder of the Alfisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Paleustalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, thermic Typic Paleustalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the underlying material within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(9)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(11)*. Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aspermont Series

The Aspermont series consists of very deep, well drained, moderately permeable, gently sloping soils on uplands (fig. 20). These soils formed in calcareous,

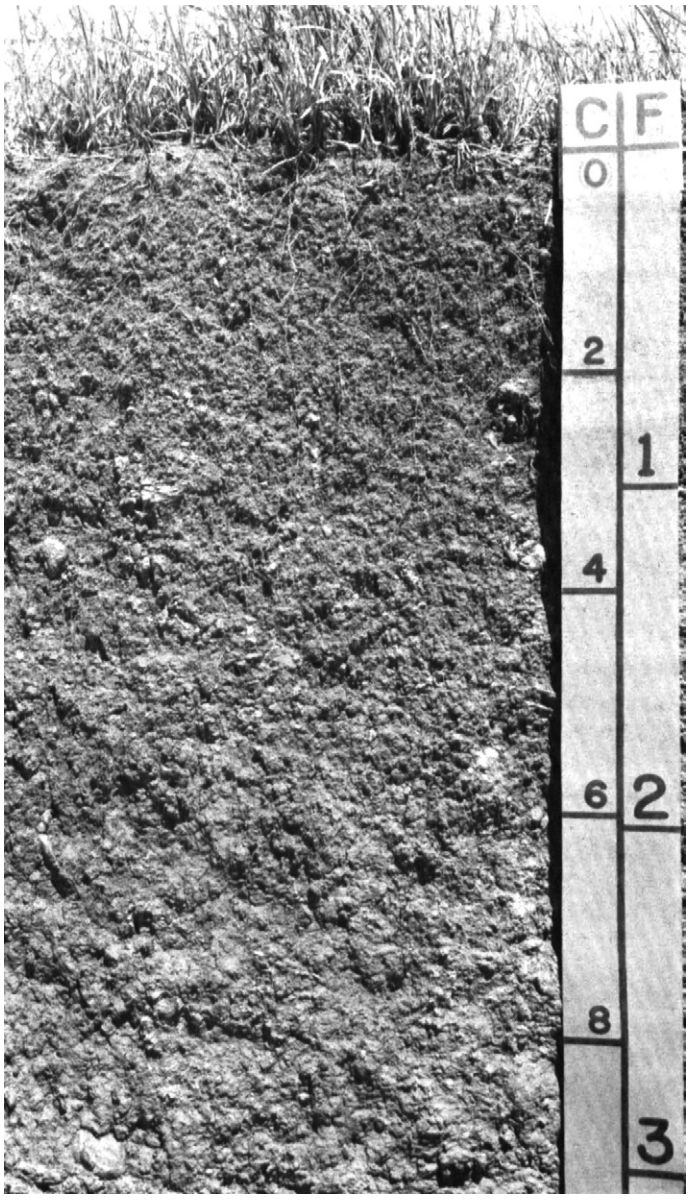

Figure 20.—A profile of Aspermont clay loam. Calcium carbonate concretions are throughout the profile.

loamy alluvial material overlying silty and clayey red beds. They are fine-silty, mixed, thermic Typic Ustochrepts. Slopes range from 1 to 5 percent.

Typical pedon of Aspermont clay loam, 1 to 5 percent slopes, eroded; from the intersection of U.S. Highway 82 and State Highway 25 in Mankins, 2.9 miles southwest on U.S. Highway 82, about 4.7 miles south on Farm Road 368, about 0.2 mile west on a county gravel road, and 450 feet north in an area of rangeland (State plane coordinates 741,500 feet N., 1,590,650 feet E.):

A—0 to 7 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, firm; many fine and medium roots; very few fine concretions of calcium carbonate; few medium iron and manganese concretions; calcareous; moderately alkaline; gradual smooth boundary.

Bk1—7 to 21 inches; reddish brown (5YR 4/4) clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; common fine and medium roots; about 10 percent, by volume, soft masses and medium and coarse concretions of calcium carbonate; common fine and medium black stains and iron and manganese concretions; calcareous; moderately alkaline; gradual smooth boundary.

Bk2—21 to 40 inches; reddish brown (2.5YR 5/4) clay loam, reddish brown (2.5YR 4/4) moist; moderate medium blocky structure; very hard, firm; few fine and medium roots; about 30 percent, by volume, soft masses and medium and coarse concretions of calcium carbonate; common fine and medium black stains and iron and manganese concretions; calcareous; moderately alkaline; abrupt smooth boundary.

B/Ck—40 to 80 inches; reddish brown (2.5YR 5/4) silty clay loam, reddish brown (2.5YR 4/4) moist; massive; very hard, very firm; about 10 percent, by volume, calcium carbonate concretions 0.5 inch to 2.0 inches in diameter; about 25 percent partially weathered red-bed shale; common medium and coarse soft bodies of calcium carbonate in the upper part; common black stains and iron and manganese concretions; calcareous; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. The content of clay in the 10- to 40-inch control section ranges from 27 to 35 percent. Calcium carbonate equivalent ranges from 7 to 35 percent. The depth to a distinct zone of calcium carbonate ranges from 12 to 18 inches. The percentage of the surface covered by coarse fragments ranges from 0 to 15 percent. The fragments are mostly pebble-sized concretions.

The A horizon is 2 to 8 inches thick. It is brown or reddish brown.

The B horizon is reddish brown, yellowish red, or red. It is silty clay loam or clay loam.

The B/Ck horizon dominantly has colors in shades of

red and brown. The partially weathered red-bed shale is in shades of red, brown, yellow, and gray.

Bluegrove Series

The Bluegrove series consists of moderately deep, well drained, moderately slowly permeable, gently sloping soils on uplands. These soils formed in interbedded sandstone and shale bedrock of Permian age. They are fine, mixed, thermic Typic Haplustalfs. Slopes range from 1 to 5 percent.

Typical pedon of Bluegrove fine sandy loam, 1 to 5 percent slopes; from the intersection of State Highway 79 and State Highway 25 in Archer City, 6.2 miles south on State Highway 79, about 3.5 miles east and 2.2 miles south on county roads, and 150 feet west in an area of rangeland (State plane coordinates 661,033 feet N., 1,663,833 feet E.):

A—0 to 8 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable; common fine and medium roots; neutral; clear smooth boundary.

Bt1—8 to 20 inches; reddish brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) moist; moderate medium prismatic structure (fig. 21) parting to moderate medium subangular blocky; extremely hard, very firm; common fine and medium roots; common medium pores; common continuous clay films on faces of peds; neutral; clear smooth boundary.

Bt2—20 to 29 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; common medium distinct brownish yellow (10YR 6/8) and red (2.5YR 4/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; few fine roots; few medium pores; common patchy clay films on faces of peds; common medium black stains and concretions; thin discontinuous layers of soft sandstone bedrock; neutral; abrupt smooth boundary.

Cr—29 to 45 inches; pale yellow (2.5Y 7/4), weakly cemented sandstone bedrock, light yellowish brown (2.5Y 6/4) moist; interlayered with thin strata and streaks of light gray (2.5Y 7/2), brownish yellow (10YR 6/6), red (2.5YR 5/8), and black (N 2/0); hardness increases with depth.

The thickness of the solum and the depth to soft bedrock range from 20 to 40 inches. The content of clay in the upper 20 inches of the Bt horizon ranges from 35 to 45 percent.

The A horizon is 5 to 12 inches thick. It is reddish brown, brown, or dark brown. Reaction is moderately acid to neutral.

The Bt horizon generally is reddish brown, yellowish red, or red sandy clay, clay loam, or clay. Some pedons are sandy clay loam in the upper part of the Bt horizon. Mottles in shades of yellow, brown, or red are common in most pedons, especially in the lower part. Reaction is moderately acid to slightly alkaline. Thin discontinuous layers of soft sandstone bedrock comprise 0 to 30 percent, by volume, of the lower 12 inches of this horizon.

The Cr horizon is weakly cemented sandstone bedrock that grades to strongly cemented sandstone bedrock with increasing depth. It has colors in shades of red to olive. The number of coatings of calcium carbonate in fissures and crevices ranges from none to many.

Bonti Series

The Bonti series consists of moderately deep, well drained, moderately slowly permeable, gently sloping soils on uplands. These soils formed in material weathered from sandstone bedrock. They are fine, mixed, thermic Ultic Paleustalfs. Slopes range from 1 to 5 percent.

Typical pedon of Bonti fine sandy loam, 1 to 5 percent slopes; from the intersection of State Highway 79 and State Highway 25 in Archer City, 8.3 miles south on State Highway 79, about 3.1 miles east on a county road, 3.5 miles south on a county road, 2.5 miles southwest on a county road, 0.2 mile west on an oil field/ranch road, 0.3 mile south on an oil field/ranch road, 0.3 mile south from a fence, 600 feet west along a second fence, and 130 feet north in an area of rangeland (State plane coordinates 631,928 feet N., 1,656,833 feet E.):

A—0 to 7 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; moderate medium granular structure; soft, friable; common fine and medium roots; moderately acid; abrupt smooth boundary.

Bt1—7 to 16 inches; reddish brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; strong coarse prismatic structure; extremely hard, very firm; many fine and medium roots; common medium fine pores; common thick continuous clay films; neutral; clear smooth boundary.

Bt2—16 to 25 inches; reddish brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very

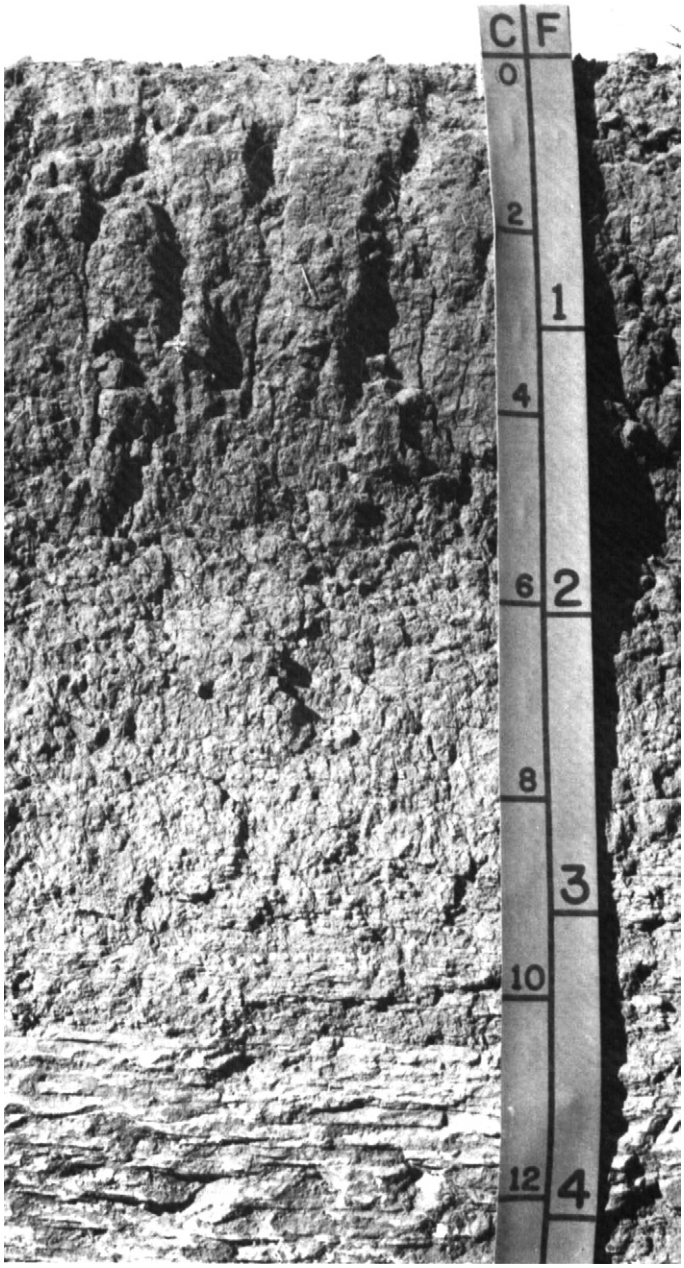

Figure 21.—A profile of Bluegrove fine sandy loam. Medium and coarse prismatic structure is evident between depths of 8 and 20 inches.

firm; common fine and medium roots; few fine pores; common thick continuous clay films; neutral; clear smooth boundary.

Bt3—25 to 35 inches; reddish brown (5YR 4/4) sandy clay, reddish brown (5YR 4/4) moist; common medium distinct yellowish red (5YR 5/6 and 5/8) and dark red (2.5YR 3/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; few fine black concretions; patchy clay films; few sandstone fragments less than 3 inches across; slightly acid; abrupt smooth boundary.

R—35 to 60 inches; yellowish red (5YR 5/6), strongly cemented sandstone bedrock; many very fine and fine white masses of shale.

The thickness of the solum and the depth to sandstone bedrock range from 20 to 40 inches. The thickness of the Bt horizon ranges from 14 to 34 inches. The content of sandstone fragments in the A horizon ranges from 0 to about 15 percent, by volume. The fragments range from 0.125 inch to 20 inches in diameter. The content of fragments in the Bt horizon ranges from 0 to 15 percent, by volume. The fragments are mainly less than 3 inches in diameter.

The A horizon is brown, yellowish brown, or dark yellowish brown. Reaction ranges from moderately acid to neutral.

The Bt1 horizon is brown, pale brown, light yellowish brown, light brown, grayish brown, reddish brown, or reddish yellow. Reaction ranges from moderately acid to neutral.

The Bt2 horizon is red, yellowish red, reddish brown, or light reddish brown. Reaction is strongly acid to neutral.

The Bt3 horizon is red, yellowish red, reddish brown, or light reddish brown. It commonly has a few dark red, reddish yellow, strong brown, yellowish brown, reddish brown, or yellowish red mottles. It is sandy clay or clay loam. Reaction is strongly acid to neutral.

Some pedons have a BC horizon, which has as much as 35 percent sandstone fragments.

The R horizon dominantly is reddish or yellowish sandstone bedrock that is hard or extremely hard when dry and extremely resistant to pressure when moist. Thin strata of shale or clay are common. Many very fine and fine white masses of shale are embedded in the sandstone bedrock.

The Bonti soils in this survey area are outside the range defined for the series because they are not so acid in the subsoil as is typical for the series. This difference, however, does not adversely affect use and management of the soils.

Darnell Series

The Darnell series consists of shallow, well drained to somewhat excessively drained, moderately rapidly permeable, gently sloping to strongly sloping soils on uplands. These soils formed in material weathered from

sandstone bedrock of Pennsylvanian age. They are loamy, siliceous, thermic, shallow Udic Ustochrepts. Slopes range from 2 to 15 percent.

Typical pedon of Darnell fine sandy loam in an area of Darnell-Exray complex, 2 to 15 percent slopes, stony; from the intersection of U.S. Highway 281 and State Highway 25 in Windthorst, about 6.7 miles south on U.S. Highway 281 and 5.5 miles south on State Highway 16, in a roadcut on the west side of the road; 15 feet south of the Exray soils site (State plane coordinates 633,758 feet N., 1,709,175 feet E.):

A—0 to 4 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine and medium granular structure; loose, very friable; many fine and medium and few coarse roots; moderately acid; clear wavy boundary.

Bw—4 to 11 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine and medium granular structure; loose, very friable; many fine and medium and few coarse roots; about 20 percent, by volume, sandstone fragments 0.5 inch to 3.0 inches across; strongly acid; abrupt smooth boundary.

Cr—11 to 40 inches; strong brown (7.5YR 5/8) and reddish yellow (5YR 6/8), weakly cemented sandstone bedrock; common black streaks; strongly acid.

The solum ranges from 10 to 15 inches in thickness and corresponds to the depth to sandstone bedrock. Coarse fragments 10 to 60 inches in diameter cover as much as 35 percent of the surface.

The A horizon is brown, light yellowish brown, or yellowish brown. It is fine sandy loam, loam, stony fine sandy loam, or stony loam. The content of coarse fragments ranges from 0 to 20 percent, by volume. The fragments range from 1 to 20 inches in diameter. Reaction ranges from strongly acid to neutral.

The Bw horizon is brown, yellowish brown, light yellowish brown, strong brown, light brown, reddish yellow, or yellowish red. It is fine sandy loam, loam, gravelly fine sandy loam, or gravelly loam. The content of coarse fragments ranges from 0 to 35 percent, by volume. The fragments range from 0.5 inch to 3.0 inches in diameter. Reaction ranges from strongly acid to neutral.

The Cr horizon is weakly cemented or strongly cemented sandstone bedrock that can be cut with a spade or auger. It generally is yellowish brown, brownish yellow, reddish yellow, or strong brown and is often stratified with two or more of these colors. Black streaks also are common. Reaction ranges from strongly acid to neutral.

Deandale Series

The Deandale series consists of very deep, moderately well drained, very slowly permeable, nearly level and gently sloping soils on upland plains. These soils formed in old alluvium derived from Permian red-bed clays and shales. They are fine, montmorillonitic, thermic Pachic Paleustolls. Slopes range from 0 to 3 percent.

Typical pedon of Deandale silt loam, 0 to 1 percent slopes; from the intersection of State Highway 79 and State Highway 25 in Archer City, 11.0 miles northwest on State Highway 25, about 0.8 mile west-southwest on a ranch road, and 500 feet north in an area of rangeland (State plane coordinates 740,177 feet N., 1,615,683 feet E.):

A—0 to 8 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable; many fine and medium roots; many fine and medium pores; slightly acid; abrupt smooth boundary.

Bt—8 to 17 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; common medium roots; few silt coatings between prisms; thick continuous clay films on faces of peds; few black concretions; slightly alkaline; gradual smooth boundary.

Btk1—17 to 22 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium blocky; very hard, very firm; common medium roots; thick continuous clay films on faces of peds; common pressure faces; common soft masses and concretions of calcium carbonate; few black concretions; calcareous; moderately alkaline; gradual smooth boundary.

Btk2—22 to 28 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium blocky; extremely hard, very firm; common medium roots; thick continuous clay films on faces of peds; common pressure faces; few small slickensides; common soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Btk3—28 to 44 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium blocky; extremely hard, very firm; few medium roots; thin continuous clay films on faces of peds; few small slickensides;

common soft masses and concretions of calcium carbonate; few black concretions; calcareous; moderately alkaline; gradual smooth boundary.

B't—44 to 80 inches; light reddish brown (5YR 6/4) clay, reddish brown (5YR 5/4) moist; weak medium blocky structure; extremely hard, very firm; few very fine roots; thin continuous clay films on faces of peds; few small slickensides; few black concretions; few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The depth to secondary carbonates ranges from 12 to 18 inches.

The A horizon is 5 to 12 inches thick. It is very dark grayish brown, dark grayish brown, dark brown, pale brown, or brown loam or silt loam. It is slightly acid to moderately alkaline.

The Bt and Btk horizons are very dark grayish brown, dark grayish brown, dark brown, or brown. They are clay or clay loam. Reaction is slightly alkaline or moderately alkaline.

The B't horizon is reddish brown, light reddish brown, yellowish red, reddish yellow, red, or light red. It is clay or clay loam.

Some pedons have a C horizon of clay and partially weathered shale bedrock in shades of red, yellow, olive, or gray. The horizon is below a depth of 60 inches.

Exray Series

The Exray series consists of shallow, well drained, moderately slowly permeable, gently sloping to strongly sloping soils on ridges, divides, and side slopes. These soils formed in material weathered from sandstone bedrock interbedded with clay. They are clayey, mixed, thermic Lithic Rhodustalfs. Slopes range from 2 to 15 percent.

Typical pedon of Exray fine sandy loam in an area of Darnell-Exray complex, 2 to 15 percent slopes, stony; from the intersection of U.S. Highway 281 and State Highway 25 in Windthorst, about 6.7 miles south on U.S. Highway 281 and 5.5 miles south on State Highway 16, in a roadcut on the west side of the road; 15 feet north of the Darnell soils site (State plane coordinates 633,773 feet N., 1,709,175 feet E.):

A—0 to 5 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium granular structure; soft, very friable; many fine and medium and few coarse roots; slightly acid; abrupt smooth boundary.

Bt1—5 to 12 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak fine prismatic structure parting to moderate fine blocky; extremely hard, very firm; common fine and medium and few coarse roots; thin continuous clay films on faces of peds; moderately acid; clear smooth boundary.

Bt2—12 to 18 inches; yellowish red (5YR 5/6) gravelly clay, yellowish red (5YR 4/6) moist; moderate fine blocky structure; extremely hard, very firm; common fine and medium and few coarse roots; thin continuous clay films on faces of peds; about 20 percent, by volume, soft sandstone fragments 0.5 inch to 3.0 inches across; moderately acid; abrupt smooth boundary.

R—18 to 40 inches; yellow (10YR 7/6), cemented sandstone bedrock, yellowish brown (10YR 5/6) moist.

The solum ranges from 12 to 18 inches in thickness and corresponds to the depth to sandstone bedrock. Coarse fragments 10 to 60 inches in diameter cover as much as 35 percent of the surface.

The A horizon is yellowish brown, brown, or dark yellowish brown fine sandy loam, loam, stony fine sandy loam, or stony loam. The content of coarse fragments ranges from 0 to 20 percent, by volume. The fragments range from 1 to 20 inches in diameter. Reaction is slightly acid or neutral.

The Bt horizon is reddish brown, yellowish red, or red. It is clay, clay loam, or sandy clay in the upper part and the gravelly analogs of those textures in the lower part. The content of coarse fragments in the lower part ranges from 10 to 25 percent, by volume. The fragments are weakly cemented sandstone. They range in size from 0.5 inch to 3.0 inches in diameter. Reaction is moderately acid or slightly acid.

The Exray soils in this survey area are outside the range defined for the series because the subsoil has value of more than 3 when it is moist. This difference, however, does not adversely affect use and management of the soils.

Gracemore Series

The Gracemore series consists of very deep, somewhat poorly drained, moderately rapidly permeable and rapidly permeable, nearly level soils on flood plains. These soils formed in recent alluvium. They are sandy, mixed, thermic Aquic Udifluvents. Slopes are 0 to 1 percent.

Typical pedon of Gracemore fine sandy loam, frequently flooded; from the intersection of State Highway 2846 and U.S. Highway 82 in Dundee, 5.7 miles north on State Highway 2846, about 0.7 mile north and west on a county road, 700 feet north along a fence, 300 feet northwest across a pasture to a

riverbank, and 150 feet northwest on the flood plain (State plane coordinates 787,242 feet N., 1,572,592 feet E.):

A—0 to 5 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak fine and medium granular structure; soft, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1—5 to 12 inches; reddish yellow (5YR 7/6) loamy fine sand, reddish yellow (5YR 6/6) moist; single grained; loose, very friable; calcareous; moderately alkaline; clear smooth boundary.

C2—12 to 80 inches; reddish yellow (5YR 7/6) loamy fine sand, reddish yellow (5YR 6/6) moist; single grained; loose, very friable; strata of reddish brown clay and clay loam 0.5 inch to 1.5 inches thick and strata of pink loamy sand 6.0 to 8.0 inches thick; evidence of bedding planes; few fine gravels; saturated at a depth of about 38 inches; calcareous; moderately alkaline.

The A horizon is 2 to 12 inches thick. It is reddish brown, light reddish brown, yellowish red, or reddish yellow. It ranges from fine sand to clay loam. Reaction is slightly alkaline or moderately alkaline.

The C horizon is red, reddish brown, light reddish brown, reddish yellow, pink, pinkish white, pinkish gray, or light gray. It ranges from fine sand to loamy fine sand that has thin strata of finer material. Reaction is slightly alkaline or moderately alkaline.

Grandfield Series

The Grandfield series consists of very deep, well drained, moderately permeable, gently sloping soils on erosional uplands, in valleys, and on terraces. These soils formed in loamy and sandy old alluvium and eolian material from nearby stream channels. They are fine-loamy, mixed, thermic Typic Haplustalfs. Slopes range from 1 to 5 percent.

Typical pedon of Grandfield fine sandy loam, 1 to 5 percent slopes; from the intersection of State Highway 79 and State Highway 25 in Archer City, 6.9 miles north on State Highway 79, about 0.5 mile east on a ranch/oil field road, and 75 feet south in an area of rangeland (State plane coordinates 736,842 feet N., 1,665,175 feet E.):

A—0 to 6 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure parting to moderate medium granular; soft, very friable; many fine and medium roots; few iron and manganese concretions 2 to 5 millimeters across; slightly acid; clear smooth boundary.

Bt1—6 to 12 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak fine prismatic structure parting to moderate medium subangular blocky; very hard, firm; many fine and medium roots; patchy clay films on faces of peds; few iron and manganese concretions 2 to 5 millimeters across; slightly acid; gradual smooth boundary.

Bt2—12 to 24 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium and coarse prismatic structure; very hard, firm; common fine and medium roots; patchy clay films on faces of peds; few iron and manganese concretions 2 to 5 millimeters across; neutral; gradual smooth boundary.

Bt3—24 to 36 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium prismatic structure; very hard, firm; few fine and medium roots; patchy clay films on faces of peds; common iron and manganese concretions 2 to 10 millimeters across; soft black stains on faces of peds; neutral; gradual smooth boundary.

Bt4—36 to 54 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine prismatic structure parting to moderate medium granular; hard, friable; few medium and coarse roots; patchy clay films on faces of peds; few iron and manganese stains and concretions 2 to 5 millimeters across; slightly alkaline; gradual smooth boundary.

BC—54 to 80 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; common medium distinct yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; hard, friable; moderately alkaline.

The solum ranges from 50 to more than 80 inches in thickness. Some pedons are calcareous below a depth of 50 inches.

The A horizon is brown or reddish brown. Reaction is slightly acid or neutral.

The upper part of the Bt horizon is brown, reddish brown, yellowish red, or red. Reaction is slightly acid or neutral. The lower part of the Bt horizon is reddish brown, reddish yellow, yellowish red, light red, or red. It is sandy clay loam or fine sandy loam. Reaction is neutral to moderately alkaline.

The BC and C horizons, if they occur, have colors similar to those of the lower part of the Bt horizon. They are fine sandy loam or loamy fine sand. In some pedons they are stratified with coarser textured or finer textured material and poorly graded siliceous gravel.

Hollister Series

The Hollister series consists of very deep, well drained, slowly permeable, nearly level and gently sloping soils on upland plains and old stream terraces. These soils formed in calcareous clay, mainly of Permian age. They are fine, mixed, thermic Pachic Paleustolls. Slopes range from 0 to 3 percent.

Typical pedon of Hollister silty clay loam, 0 to 1 percent slopes; from the intersection of State Highway 25 and U.S. Highway 82 in Mankins, 7.3 miles southeast on State Highway 25, about 2.6 miles east on a county gravel road, and 120 feet north in an area of rangeland (State plane coordinates 751,000 feet N., 1,620,675 feet E.):

A—0 to 9 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; many fine and medium roots; few fine pores; slightly alkaline; gradual smooth boundary.

Bt—9 to 22 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak coarse prismatic structure parting to strong medium subangular blocky; very hard, very firm; common fine and medium roots; common thin continuous clay films; few calcium carbonate concretions 1 to 3 millimeters in diameter; moderately alkaline; gradual smooth boundary.

Btk1—22 to 36 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; weak coarse prismatic structure parting to strong medium subangular blocky; extremely hard, very firm; common fine and medium roots; common thin continuous clay films; common calcium carbonate concretions 2 to 8 millimeters in diameter; calcareous; moderately alkaline; gradual smooth boundary.

Btk2—36 to 58 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; few fine roots; common fine and medium calcium carbonate concretions 2 to 8 millimeters in diameter; calcareous; moderately alkaline; gradual smooth boundary.

Btk3—58 to 80 inches; reddish yellow (5YR 6/6) clay, yellowish red (5YR 5/6) moist; weak fine prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; many calcium carbonate concretions 3 to 15 millimeters in diameter; calcareous; moderately alkaline.

The solum ranges from 60 to more than 90 inches in thickness. The mollic epipedon ranges from 20 to 48 inches in thickness. It includes the A horizon and the upper part of the Bt horizon. The depth to calcareous material ranges from 5 to 23 inches.

The A horizon is 5 to 13 inches thick. It is dark brown, brown, dark grayish brown, or grayish brown. Reaction ranges from neutral to moderately alkaline.

The B horizon is dark brown, brown, dark grayish brown, or grayish brown in the upper part and reddish brown, yellowish red, reddish yellow, or red in the lower part. It is clay, clay loam, or silty clay loam. Reaction is slightly alkaline or moderately alkaline.

Some pedons have a C horizon, which is dark reddish brown, dark red, red, weak red, reddish brown, or yellowish red clay interlayered with platy shale in shades of gray.

Jolly Series

The Jolly series consists of shallow, well drained, moderately permeable, gently sloping to strongly sloping soils on uplands (fig. 22). These soils formed in fine grained and medium grained material weathered from sandstone bedrock of Permian age. They are loamy, siliceous, thermic, shallow Typic Haplustalfs. Slopes range from 2 to 12 percent.

Typical pedon of Jolly fine sandy loam in an area of Jolly-Rock outcrop complex, 2 to 12 percent slopes, stony; from the intersection of State Highway 79 and State Highway 25 in Archer City, about 5.2 miles north on State Highway 79, about 0.7 mile west-northwest on a ranch road, and 75 feet south in an area of rangeland (State plane coordinates 736,256 feet N., 1,658,885 feet E.):

A—0 to 5 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure parting to moderate medium granular; loose, very friable; many fine and medium roots; sandstone fragments as much as 36 inches across cover about 5 percent of the surface; neutral; abrupt smooth boundary.

Bt—5 to 11 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, very firm; many fine and medium roots; many fine and medium pores; common continuous clay films on faces of peds; slightly acid; clear smooth boundary.

Btc/C—11 to 18 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak fine prismatic structure parting to moderate medium subangular blocky; hard, firm; many fine and medium roots; few medium pores; common thin patchy clay films on faces of peds; common

Figure 22.—A roadcut showing Jolly fine sandy loam. Small sandstone fragments are in the subsoil layer directly above the sandstone bedrock.

medium black concretions; about 30 percent discontinuous layers of soft sandstone fragments less than 3 inches across (C part); slightly acid; abrupt smooth boundary.

Cr—18 to 40 inches; pale yellow (5Y 7/3), weakly cemented sandstone bedrock, pale olive (5Y 6/3) moist; few coarse distinct yellowish brown (10YR 5/8) mottles and streaks; common black streaks.

The thickness of the solum and the depth to sandstone bedrock range from 12 to 20 inches. The weighted average of coarse fragments in the solum ranges from 0 to about 30 percent. The fragments are partially weathered, soft sandstone gravels, cobbles, or flagstones. Coarse fragments cover 2 to about 10 percent of the surface. The fragments are gravel to stone size with a few outcrops of sandstone bedrock.

The A horizon is reddish brown, brown, or dark brown. It is 2 to 9 inches thick. Reaction ranges from moderately acid to neutral.

The Bt and Btc/C horizons are reddish brown, brown, or dark brown. The content of clay ranges from 20 to 30 percent. The content of sandstone fragments 0.5 inch to 3 inches across ranges from 0 to 15 percent, by volume, in the Bt horizon and from 10 to 40 percent, by volume, in the Btc/C horizon. Reaction is slightly acid or neutral.

The Cr horizon is weakly cemented or strongly cemented, noncalcareous, horizontally layered sandstone bedrock in shades of brown, yellow, gray, or olive. In some pedons it has coarse reddish and brownish mottles and black streaks. This horizon has a hardness rating of 1 to 3 on the Mohs scale. In some pedons the sandstone bedrock below a depth of 40 inches has a hardness rating of more than 3 on the Mohs scale.

Kamay Series

The Kamay series consists of very deep, well drained, slowly permeable, nearly level and very gently sloping soils on upland plains, divides, and old stream terraces. These soils formed in ancient alluvium derived from red-bed clays and shales. They are fine, montmorillonitic, thermic Typic Paleustalfs. Slopes range from 0 to 3 percent.

Typical pedon of Kamay silt loam, 1 to 3 percent slopes; from the intersection of State Highway 25 and State Highway 79 in Archer City, 2.7 miles west on State Highway 25, about 7.1 miles west on Farm Road 210, about 0.9 mile south along a fence, and 150 feet east (State plane coordinates 643,033 feet N., 1,608,733 feet E.):

A—0 to 7 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; many fine and few medium roots; slightly acid; abrupt smooth boundary.

Bt—7 to 11 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; common fine and few medium roots; patchy clay films of faces of peds; slightly alkaline; clear smooth boundary.

Btk1—11 to 45 inches; reddish brown (5YR 4/4) clay; dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure; extremely hard, very firm; common clay films of faces of peds; few fine roots; common calcium carbonate concretions and

soft masses 3 to 20 millimeters across; calcareous; moderately alkaline; gradual smooth boundary.

Btk2—45 to 57 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm; common clay films on faces of peds; common calcium carbonate concretions and soft masses 3 to 12 millimeters across; common iron and manganese concretions 2 to 5 millimeters across; common black streaks on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.

BC—57 to 80 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure parting to strong medium angular blocky; extremely hard, extremely firm; common calcium carbonate concretions 2 to 5 millimeters across; few black stains; common light greenish gray (5G 7/1) shale fragments; calcareous; moderately alkaline; gradual smooth boundary.

C—80 to 90 inches; dark reddish brown (2.5YR 3/4) clay, dark reddish brown (2.5YR 3/4) moist; interlayered with light greenish gray (5G 7/1) shale; moderate fine and medium platy structure.

The solum ranges from 60 to more than 80 inches to contact with interbedded clays and shales. The depth to secondary carbonates ranges from 11 to 20 inches.

The A horizon is 5 to 12 inches thick. It is brown or reddish brown. It is slightly acid to slightly alkaline.

The Bt horizon is slightly alkaline or moderately alkaline. Calcium carbonate concretions make up 0 to less than 2 percent of the volume.

The Btk horizon is reddish brown, dark reddish brown, yellowish red, reddish yellow, or red. It is clay or clay loam. Calcium carbonate in the form of concretions and soft masses makes up 1 to 5 percent of the volume.

The C horizon, if it occurs, is brownish or reddish clay interlayered with platy shale in shades of gray and olive.

Knoco Series

The Knoco series consists of shallow and very shallow, excessively drained, very slowly permeable, gently sloping to steep erosional soils on uplands. These soils formed in Permian red-bed clays and shales. They are clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents. Slopes range from 2 to 45 percent.

Typical pedon of Knoco gravelly clay in an area of Knoco-Vernon complex, 2 to 12 percent slopes; from the intersection of State Highway 79 and State Highway 25 in Archer City, 2.3 miles south on State Highway 79, about 0.4 mile northwest on a ranch road, and 950 feet west in an area of eroded rangeland (State plane coordinates 693,450 feet N., 1,651,450 feet E.):

A—0 to 3 inches; reddish brown (5YR 5/4) gravelly clay, reddish brown (5YR 4/4) moist; moderate medium blocky structure; very hard, very firm; common fine and medium roots; few fine calcium carbonate concretions; pebbles 5 to 40 millimeters in diameter make up about 35 percent, by volume, within the soil and cover about 75 percent of the surface; calcareous; moderately alkaline; clear smooth boundary.

C—3 to 9 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; common weak red (10R 4/2) and yellowish brown (10YR 5/6) splotches and strata; gray (5Y 5/1) horizontally oriented shale fragments; weak fine angular blocky structure; extremely hard, very firm; few fine roots; common faint pressure faces; few fine calcium carbonate concretions; calcareous; moderately alkaline; abrupt smooth boundary.

Cr—9 to 40 inches; dusky red (10R 3/4) shale having a clayey texture, dusky red (10R 3/4) moist; common medium prominent greenish gray (5G 5/1) and yellowish brown (10YR 5/6) splotches; strong fine and very fine angular blocky structure; extremely hard, extremely firm; few fine calcium carbonate concretions in the upper part; calcareous; moderately alkaline.

The thickness of the solum and the depth to shale range from 3 to 14 inches. The soil generally is calcareous throughout. Pebble-sized concretions cover 50 to 100 percent of the surface. Sandstone cobbles and boulders cover 0 to 70 percent of the surface.

The A horizon is 2 to 9 inches thick. It is reddish brown clay or gravelly clay. The content of fragments within the horizon ranges from 0 to 35 percent, by volume. The fragments are mostly pebbles that are less than 2 inches in diameter. Calcium carbonate concretions make up 0 to 5 percent of the volume.

The C horizon, if it occurs, is as much as 10 inches thick. It is reddish brown clay that is mottled or streaked in shades of brown, red, and gray. Calcium carbonate concretions make up 0 to 5 percent of the volume.

The Cr horizon is shades of red, brown, or gray; is mottled with a combination of these colors; or is stratified with these colors.

Latom Series

The Latom series consists of very shallow, well drained, moderately permeable, gently sloping to strongly sloping soils on erosional uplands. These soils formed in loamy material weathered from strongly cemented, calcareous sandstone bedrock. They are loamy, mixed (calcareous), thermic Lithic Ustic Torriorthents. Slopes range from 3 to 12 percent.

Typical pedon of Latom fine sandy loam in an area of Vernon-Latom complex, 3 to 12 percent slopes, stony; from the intersection of Farm Road 2846 and U.S. Highway 82 in Dundee, 1.7 miles north on Farm Road 2846 and 0.7 mile west in an area of rangeland (State plane coordinates 767,414 feet N., 1,571,920 feet E.):

A—0 to 6 inches; reddish brown (2.5YR 5/4) fine sandy loam, reddish brown (2.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable; few fine roots; common fine pores; few sandstone fragments as much as 12 inches across; calcareous; moderately alkaline; abrupt wavy boundary.

C—6 to 10 inches; weak red (2.5YR 4/2), partially weathered, weakly consolidated sandstone bedrock, dusky red (2.5YR 3/2) moist; common medium distinct red splotches; fine sandy loam in sandstone bedrock crevices; calcareous; moderately alkaline; abrupt wavy boundary.

R—10 to 20 inches; weak red (2.5YR 5/2), strongly cemented sandstone bedrock; thin discontinuous coatings of calcium carbonate in crevices; calcareous; moderately alkaline.

The solum ranges from 6 to 10 inches in thickness and corresponds to the depth to sandstone bedrock.

The A horizon is reddish brown or red. The content of sandstone fragments ranges from 0 to 15 percent in the surface horizon. The fragments range from less than 1 inch to about 12 inches in diameter.

The C horizon has very few to about 10 percent discontinuous films and soft nodules of calcium carbonate. Some pedons do not have a C horizon.

Mangum Series

The Mangum series consists of very deep, well drained or moderately well drained, very slowly permeable, nearly level soils on flood plains. These soils formed in calcareous, clayey, alluvial sediments. They are fine, mixed, thermic Vertic Ustochrepts. Slopes are 0 to 1 percent.

Typical pedon of Mangum clay, occasionally flooded; from the intersection of U.S. Highway 281 and Farm Road 172 in Scotland, 3.1 miles north on U.S. Highway 281, about 2.4 miles west on a county road, 1.0 mile south on a ranch road to a windmill and a fence, and 1,680 feet south in an area of rangeland (State plane coordinates 731,500 feet N., 1,692,458 feet E.):

A—0 to 5 inches; brown (7.5YR 5/2) clay, reddish brown (5YR 4/3) moist; moderate medium blocky structure; hard, firm; few fine roots; few very fine pores; calcareous; moderately alkaline; clear smooth boundary.

Bss—5 to 16 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/3) moist; moderate fine and medium blocky structure; extremely hard, very firm; few fine black concretions; few very fine pores; many shiny slickensides that angle approximately 30 degrees from horizontal; cracks about 0.5 inch wide extend from top to bottom of this horizon; calcareous; moderately alkaline; abrupt smooth boundary.

C1—16 to 41 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/3) moist; massive; extremely hard, very firm; few fine and medium black concretions; few medium soft bodies of calcium carbonate; many shiny slickensides that angle approximately 30 degrees from horizontal; cracks about 0.5 inch wide extend to a depth of about 22 inches in this horizon; calcareous; moderately alkaline; gradual smooth boundary.

C2—41 to 80 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2 and 3/2) moist; massive; extremely hard, very firm; few fine black concretions; calcareous; moderately alkaline.

The combined thickness of the A and B horizons is 15 to 50 inches. Cracks as much as 1 inch wide extend to a depth of 30 inches. Electrical conductivity ranges from less than 1 millimho to more than 8 millimhos per cubic centimeter.

The A horizon is 5 to 16 inches thick. It is reddish brown, light reddish brown, red, yellowish red, or brown. It is clay, silty clay, or silty clay loam.

The Bss horizon is 8 to 36 inches thick. It is light reddish brown, reddish brown, light red, red, reddish yellow, or yellowish red clay or silty clay.

The C horizon is light reddish brown, reddish brown, brown, light red, red, reddish yellow, or yellowish red. It is clay or silty clay that has thin strata of silt loam or very fine sandy loam.

Port Series

The Port series consists of very deep, well drained, moderately permeable, nearly level soils on flood plains. These soils formed in calcareous, loamy alluvial material. They are fine-silty, mixed, thermic Cumulic

Haplustolls. Slopes are 0 to 1 percent.

Typical pedon of Port silty clay loam in an area of Port-Wheatwood complex, occasionally flooded; from the intersection of State Highway 25 and State Highway 79 in Archer City, 2.7 miles west on State Highway 25, about 3.8 miles west on Farm Road 210, and 0.7 mile north on a flood plain (State plane coordinates 709,333 feet N., 1,624,825 feet E.):

A—0 to 11 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate medium and coarse granular structure; slightly hard, firm; many fine and medium roots; common fine and medium pores; neutral; gradual smooth boundary.

AB—11 to 21 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; weak fine prismatic structure parting to moderate medium granular; slightly hard, firm; common fine and medium roots; many fine and medium pores; neutral; gradual smooth boundary.

Bw1—21 to 28 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/2) moist; moderate fine and medium prismatic structure parting to moderate medium subangular blocky; hard, firm; common fine and medium roots; common fine and medium pores; neutral; gradual smooth boundary.

Bw2—28 to 39 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 3/4) moist; weak fine and medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few fine and common medium roots; common fine and medium pores; neutral; gradual smooth boundary.

C—39 to 80 inches; yellowish red (5YR 5/6) loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable; few medium roots; few medium pores; common bedding planes of finer material 6 to 20 millimeters thick; calcareous; moderately alkaline.

The depth to free carbonates is 20 to 60 inches or more. The A, B, and C horizons are silty clay loam, clay loam, silt loam, or loam.

The combined thickness of the A and AB horizons is 13 to 39 inches. These horizons are dark brown, reddish brown, or brown. Reaction ranges from moderately acid to slightly alkaline.

The Bw horizon is dark brown, brown, strong brown, reddish brown, or yellowish red. Reaction ranges from neutral to moderately alkaline.

The C horizon is reddish brown or yellowish red. In many pedons it has 0.25- to 1.0-inch-thick strata of coarser textured or finer textured material.

Rotan Series

The Rotan series consists of very deep, well drained, moderately slowly permeable, nearly level and very gently sloping soils on broad, smooth plains and divides in the uplands. These soils formed in calcareous ancient alluvium or outwash material. They are fine, mixed, thermic Pachic Paleustolls. Slopes range from 0 to 3 percent.

The Rotan soils in this survey area are taxadjuncts to the series because the mineralogy is montmorillonitic. This difference, however, does not adversely affect use and management of the soils.

Typical pedon of Rotan silty clay loam, 0 to 1 percent slopes; from the intersection of State Highway 25 and State Highway 79 in Archer City, 2.7 miles west on State Highway 25, about 2.6 miles west on Farm Road 210, about 16.8 miles south and west on Farm Road 2178 (0.1 mile north of the Young County line), 0.5 mile west on a gravel road, and 250 feet south in an area of cropland (State plane coordinates 631,942 feet N., 1,606,875 feet E.):

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to moderate medium granular; soft, friable; common very fine and few fine roots; moderately alkaline; clear smooth boundary.

Bt1—8 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few very fine and fine roots; common thick continuous clay films; very few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bt2—18 to 29 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, very firm; few very fine and fine roots; common thick continuous clay films; common fine and few medium concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bt3—29 to 47 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, very firm; common thick continuous clay films; common fine and medium concretions of calcium carbonate; few medium iron and

manganese concretions; calcareous; moderately alkaline; clear smooth boundary.

Btk—47 to 75 inches; reddish yellow (5YR 6/6) clay, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; extremely hard, extremely firm; common thick discontinuous clay films; about 25 percent, by volume, concretions of calcium carbonate; common salt crystals; few medium iron and manganese concretions; calcareous; moderately alkaline; gradual smooth boundary.

Btkc—75 to 90 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; common medium prominent light yellowish brown (2.5Y 6/4) and light gray (5Y 6/1) mottles; moderate medium blocky structure; extremely hard, extremely firm; few discontinuous clay films; common medium concretions of calcium carbonate; common salt crystals; common medium iron and manganese concretions; few soft shale fragments; calcareous; moderately alkaline.

The solum ranges from 80 to 100 inches or more in thickness. The depth to secondary carbonates is 10 to 19 inches. Depth to the calcic horizon is 30 to 55 inches. The mollic epipedon ranges from 24 to 40 inches in thickness. Cracks, which are as much as 0.5 inch wide and are less than 20 inches long, are at the surface. Reaction is slightly acid to moderately alkaline in the A horizon and slightly alkaline or moderately alkaline in the B horizon.

The A horizon is 3 to 13 inches thick. It is very dark gray, very dark grayish brown, dark gray, dark grayish brown, or dark brown. It generally is silty clay loam, but the range includes silt loam in some pedons.

The Bt horizon is very dark grayish brown, dark brown, dark yellowish brown, dark gray, or dark grayish brown. It is clay loam, silty clay loam, or clay. The content of clay is 35 to 45 percent. Structure ranges from prismatic to blocky.

The Btk horizon is pink, reddish yellow, yellowish red, very pale brown, or light reddish brown. It contains 15 to 50 percent calcium carbonate, by volume, mainly in the form of soft masses and concretions.

The Btkc horizon is yellowish red or reddish yellow.

Rowden Series

The Rowden series consists of moderately deep, well drained, slowly permeable, very gently sloping soils on upland plains. These soils formed in calcareous, loamy and clayey sediments overlying limestone. They are fine, mixed, thermic Typic Argiustolls. Slopes range from 1 to 3 percent.

Typical pedon of Rowden clay loam, 1 to 3 percent slopes; from the intersection of Farm Road 2110 and State Highway 114 in Megargel, 3.7 miles south on Farm Road 210, about 750 feet west of the road and 100 feet north of the county line, in an area of cropland (State plane coordinates 632,833 feet N., 1,563,183 feet E.):

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable; few very fine and fine roots; very fine pores; few limestone pebbles and cobbles 1 to 5 inches in diameter; few medium iron and manganese concretions; very few fine concretions of calcium carbonate; noncalcareous; moderately alkaline; clear smooth boundary.

Bt—7 to 18 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak fine prismatic structure parting to moderate medium subangular blocky; hard, firm; few very fine and fine roots; few fine pores; common thick continuous clay films on faces of peds; few fine and medium concretions of calcium carbonate; common fine iron and manganese concretions; calcareous; moderately alkaline; gradual smooth boundary.

Btkc—18 to 30 inches; dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; strong medium subangular blocky structure; very hard, firm; few fine roots; few very fine pores; common thick patchy clay films on faces of peds; common medium and coarse concretions of calcium carbonate; many fine iron and manganese concretions; calcareous; moderately alkaline; abrupt wavy boundary.

R—30 to 35 inches; light gray (5Y 7/1), indurated limestone bedrock having many salt crystals; coarsely fractured; thin calcium carbonate coatings on surface of bedrock and in fractures.

The solum ranges from 20 to 40 inches in thickness. The lower boundary of the solum either rests abruptly on limestone bedrock or grades into bedded limestone that has soil in the interstices. The content of coarse fragments ranges from 0 to 15 percent in the A and Bt horizons. Reaction is slightly alkaline or moderately alkaline throughout the profile.

The A horizon is 4 to 8 inches thick. It is dark brown, dark grayish brown, reddish brown, or dark reddish gray.

The Bt and Btkc horizons are dark brown, dark grayish brown, reddish brown, dark reddish gray, or dark yellowish brown. They are clay loam or clay. The content of clay is 35 to 55 percent.

Tillman Series

The Tillman series consists of very deep, well drained, slowly permeable, nearly level and very gently sloping soils on upland plains and old stream terraces. These soils formed in calcareous clay, mainly of Permian age. They are fine, mixed, thermic Typic Paleustolls. Slopes range from 0 to 3 percent.

Typical pedon of Tillman clay loam, 1 to 3 percent slopes; from the intersection of State Highway 25 and U.S. Highway 82 in Mankins, 7.3 miles southeast on State Highway 25, about 1.4 miles east on a county gravel road, and 550 feet south in an area of rangeland (State plane coordinates 752,363 feet N., 1,620,803 feet E.):

A—0 to 6 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; many fine and medium roots; few fine pores; moderately alkaline; clear smooth boundary.

Bt1—6 to 15 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; common fine and medium roots; few patchy clay films on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.

Bt2—15 to 33 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; common fine and few medium roots; few patchy clay films on faces of peds; few calcium carbonate concretions 1 to 5 millimeters in diameter; calcareous; moderately alkaline; gradual smooth boundary.

Btk1—33 to 59 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; common fine and medium roots; few patchy clay films on faces of peds; common calcium carbonate concretions 2 to 8 millimeters in diameter; common salt crystals; calcareous; moderately alkaline; clear smooth boundary.

Btk2—59 to 73 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium blocky structure; extremely hard, very firm; few fine and medium roots; few patchy clay films on faces of peds; common calcium carbonate concretions 2 to 14 millimeters in diameter; common salt crystals; calcareous; moderately alkaline; gradual smooth boundary.

C—73 to 80 inches; mottled reddish brown (5YR 4/4), weak red (10R 4/4), yellowish red (5YR 4/6), and light gray (5Y 7/1), partially weathered shale having a clayey texture; strong medium angular blocky structure; extremely hard, very firm; few salt crystals; calcareous; moderately alkaline.

The solum ranges from 60 to more than 90 inches in thickness. Reaction is slightly alkaline or moderately alkaline. The mollic epipedon ranges from 11 to 20 inches in thickness and includes the upper part of the B horizon. It is reddish gray, dark reddish gray, reddish brown, dark reddish brown, brown, or dark brown.

The lower part of the B horizon is reddish brown, yellowish red, or red. It is clay or clay loam.

The C horizon is shades of red, brown, or gray.

Vernon Series

The Vernon series consists of very deep, well drained, very slowly permeable, gently sloping to steep soils on uplands. These soils formed in material weathered from Permian red-bed shale. They are fine, mixed, thermic Typic Ustochrepts. Slopes range from 1 to 45 percent.

Typical pedon of Vernon clay in an area of Vernon-Knoco complex, 2 to 8 percent slopes; from the intersection of Farm Road 210 and State Highway 114 in Megargel, 1.7 miles northeast on Farm Road 210, about 4.0 miles east on a gravel road, 3,000 feet south along a fence, and 550 feet east in an area of rangeland (State plane coordinates 655,915 feet N., 1,590,560 feet E.):

A—0 to 4 inches; dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; weak medium blocky structure; very hard, very firm; common fine and medium roots; few medium calcium carbonate concretions; calcareous; moderately alkaline; clear smooth boundary.

Bk—4 to 23 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; weak medium blocky structure; very hard, very firm; few very fine and medium roots; common faint pressure faces; common fine calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.

Ck—23 to 27 inches; reddish gray (5YR 5/2) clay, dark reddish gray (5YR 4/2) moist; common medium distinct dark reddish gray (10R 4/1) and common medium prominent olive yellow (2.5Y 6/6) mottles; massive; extremely hard, very firm; few fine roots; common faint pressure faces; common fine and medium calcium carbonate concretions; calcareous;

moderately alkaline; gradual smooth boundary.
C—27 to 60 inches; mottled dark reddish gray (10R 4/1) and olive yellow (2.5Y 6/6) weathered shale having a clayey texture; common light gray (5Y 6/1) partially weathered shale fragments; massive; extremely hard, very firm; common calcium carbonate concretions, especially in upper part; calcareous; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. Typically, the soil is calcareous throughout. Pebble-sized concretions cover from 0 to 15 percent of the surface.

The A horizon ranges from 3 to 12 inches in thickness. It is dark brown, brown, or reddish brown. It is clay, silty clay, or clay loam.

The B horizon is clay or silty clay. Accumulations of calcium carbonate occur as a few films and threads to about 10 percent soft bodies and concretions.

The C horizon is reddish brown, dark reddish gray, reddish gray, weak red, gray, or dark gray.

Most pedons have a Cr horizon below a depth of 60 inches. This horizon is partially weathered shale that has a clayey texture.

Westfork Series

The Westfork series consists of very deep, well drained, very slowly permeable, nearly level soils on flood plains. These soils formed in clayey alluvium. They are fine, mixed, thermic Cumulic Haplustolls. Slopes are 0 to 1 percent.

Typical pedon of Westfork silty clay, occasionally flooded; from the intersection of U.S. Highway 281 and State Highway 25 in Windthorst, 6.7 miles south on U.S. Highway 281, about 2.5 miles south on State Highway 16, about 1.5 miles east on a county road, 0.5 mile south on a ranch road to gathering pens, and 0.7 mile southeast in an area of rangeland, which is 310 feet north of the West Fork of the Trinity River channel and 50 feet west of the Archer-Jack County line (State plane coordinates 644,350 feet N., 1,718,917 feet E.):

A1—0 to 6 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; very hard, very firm, slightly sticky and plastic; common shiny pressure faces; common fine and medium roots; common fine pores; neutral; clear smooth boundary.
A2—6 to 16 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; very hard, very firm, slightly sticky and plastic; common shiny pressure faces; common fine and medium roots; few fine pores; slightly alkaline; clear smooth boundary.
A3—16 to 21 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, firm, very sticky and plastic; common fine and few medium roots; common very fine pores; moderately alkaline; clear smooth boundary.
A4—21 to 28 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; common shiny pressure faces; common fine roots; common very fine pores; calcareous; moderately alkaline; gradual smooth boundary.
A5—28 to 38 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and plastic; common shiny pressure faces; very few small slickensides about 12 millimeters across; few fine and common very fine pores; calcareous; moderately alkaline; gradual smooth boundary.
Bw—38 to 45 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and plastic; common shiny pressure faces; very few small slickensides about 15 millimeters across; very few fine roots; common very fine pores; few medium calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.
Bk—45 to 57 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and plastic; common shiny pressure faces; few small slickensides about 15 millimeters across; common very fine pores; many medium calcium carbonate concretions; calcareous; moderately alkaline; gradual smooth boundary.
B'w—57 to 80 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to weak medium angular blocky; extremely hard, very firm, sticky and very plastic; many shiny pressure faces; few slickensides 15 to 300 millimeters across; common very fine pores; few medium calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 60 to more than 90 inches in thickness. The mollic epipedon ranges from 20 to 40 inches in thickness. The depth to secondary carbonates is 28 to 60 inches. Accumulations of carbonates occur

as a few visible threads and films to about 5 percent soft bodies and concretions. Cracks form when the soils are dry. They range from 0.5 inch to 2.0 inches in width and extend to a depth of about 18 inches.

The A horizon is dark grayish brown, dark brown, or reddish brown. It is silty clay in the upper part and silty clay, clay, or silty clay loam in the lower part. Reaction ranges from slightly acid to moderately alkaline.

The B horizon extends to a depth of more than 80 inches. It is dark grayish brown, dark brown, brown, dark reddish gray, dark reddish brown, or reddish brown. Mottles in shades of red and brown are below a depth of 44 inches in some pedons. Texture is clay, silty clay, or silty clay loam. Reaction ranges from neutral to moderately alkaline.

Weswind Series

The Weswind series consists of very deep, moderately well drained, moderately slowly permeable, gently sloping soils on uplands. These soils formed in material weathered from sandstone bedrock interbedded with thin strata of shale. They are fine, mixed, thermic Typic Paleustalfs. Slopes range from 1 to 5 percent.

Typical pedon of Weswind fine sandy loam, 1 to 5 percent slopes; from the intersection of Farm Road 210 and State Highway 114 in Megargel, 7.4 miles northeast on Farm Road 210 and 170 feet southeast in an area of rangeland (State plane coordinates 682,442 feet N., 1,588,950 feet E.):

A—0 to 5 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; many fine and medium roots; moderately acid; abrupt smooth boundary.

Bt1—5 to 12 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak fine and medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; common fine and medium roots; few fine and medium pores; few thin patchy reddish brown (5YR 4/4) clay films on faces of peds; few iron and manganese concretions 1 to 4 millimeters across; moderately acid; clear smooth boundary.

Bt2—12 to 22 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium and coarse prismatic structure; extremely hard, very firm; common fine and medium roots; common thin continuous reddish brown (5YR 4/4) clay films on faces of most peds; few iron and manganese concretions 2 to 5 millimeters across; slightly acid; gradual smooth boundary.

Bt3—22 to 48 inches; coarsely and distinctly mottled dark brown (7.5YR 4/4), yellowish red (5YR 5/8), and yellowish brown (10YR 5/6) clay; weak medium prismatic structure parting to strong medium blocky; extremely hard, very firm; common fine roots mainly on prism faces; common thin continuous reddish brown (5YR 4/4) clay films on faces of most peds; common iron and manganese concretions and soft masses 2 to 8 millimeters across; neutral; clear wavy boundary.

Bk/C—48 to 65 inches; prominently mottled weak red (10R 4/2) and yellowish brown (10YR 5/6) clay; common light gray (5Y 7/2) shale fragments; massive; extremely hard, extremely firm; about 20 percent, by volume, soft masses, films, and threads of calcium carbonate; few iron and manganese concretions and soft masses 2 to 4 millimeters across; calcareous; moderately alkaline; gradual wavy boundary.

2C—65 to 80 inches; prominently mottled weak red (10R 4/2) and yellowish brown (10YR 5/6) weathered shale having a clayey texture; common light gray (5Y 7/2) shale fragments; angular blocky structure inherited from bedrock; extremely hard, extremely firm; few soft masses of calcium carbonate on surface of fragments; few iron and manganese concretions 1 to 4 millimeters across; calcareous; moderately alkaline.

The thickness of the solum and the depth to red beds range from 60 to 80 inches. The depth to bedrock is more than 60 inches. The soils have a few to about 5 percent coarse fragments, which are siliceous ironstone or sandstone pebbles. Base saturation ranges from 75 to 90 percent, by sum of cations, in part of the Bt horizon. The average content of clay in the control section ranges from 35 to 45 percent. The boundary between the A and Bt horizons is abrupt or clear, and the texture change is abrupt.

The A horizon is 3 to 11 inches thick. It is brown, yellowish brown, or dark yellowish brown. Reaction is moderately acid or slightly acid.

The Bt1 and Bt2 horizons are brown, yellowish brown, dark yellowish brown, or reddish brown. They are clay loam, sandy clay, or clay. Reaction ranges from moderately acid to slightly alkaline.

The Bt3 horizon is brown, dark brown, strong brown, yellowish brown, reddish brown, brownish yellow, reddish yellow, or yellowish red. Faint to prominent mottles in shades of red, yellow, brown, or gray are common and often dominate the horizon. This horizon

is clay, sandy clay, or clay loam. Reaction ranges from neutral to moderately alkaline. In some pedons the lower part of the horizon contains films and threads, soft masses, or concretions of calcium carbonate.

The Bk/C horizon, if it occurs, is reddish brown, reddish yellow, yellowish red, light red, weak red, or red. Faint to prominent mottles in shades of red, brown, yellow, olive, gray, or white are common and often dominate the horizon. This horizon is commonly interbedded with thin strata of greenish gray platy shale; weakly cemented, brownish or yellowish sandstone bedrock; or alkaline loamy and clayey sediments. Calcium carbonate in the form of soft masses and films and threads makes up 5 to 25 percent of the total volume of the horizon.

The C horizon is reddish brown, reddish yellow, yellowish red, light red, weak red, or dusky red. Faint to prominent mottles in shades of red, brown, yellow, olive, gray, or white are common. The horizon is soft, weathered shale having a clayey texture and is interbedded with thin strata of greenish gray platy shale.

Wheatwood Series

The Wheatwood series consists of very deep, well drained, moderately permeable, nearly level soils on flood plains. These soils formed in calcareous, loamy, alluvial material (fig. 23). They are fine-silty, mixed, thermic Fluventic Ustochrepts. Slopes are 0 to 1 percent.

Typical pedon of Wheatwood silt loam, occasionally flooded; from the intersection of Farm Road 2846 and U.S. Highway 82 in Dundee, 5.2 miles north on Farm Road 2846 and 200 feet west in an area of cropland (State plane coordinates 785,235 feet N., 1,574,758 feet E.):

Ap—0 to 6 inches; reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure parting to moderate medium granular; slightly hard, friable; many very fine and fine pores; calcareous; moderately alkaline; abrupt smooth boundary.

Bw1—6 to 20 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak medium and fine prismatic structure; hard, friable; common very fine and fine pores; few fine roots; few wormcasts; calcareous; moderately alkaline; gradual smooth boundary.

Bw2—20 to 34 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; weak medium and fine prismatic structure; faint remnants of bedding planes evident; slightly hard, friable; few fine pores; few fine roots; few wormcasts; calcareous; moderately alkaline; gradual smooth boundary.

Bw3—34 to 45 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, friable; weak bedding planes; few fine pores; few wormcasts; calcareous; moderately alkaline; clear smooth boundary.

C1—45 to 62 inches; light reddish brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, friable; faint bedding planes; few fine pores; calcareous; moderately alkaline; clear smooth boundary.

C2—62 to 80 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; common strata of silty clay loam, silty clay, and very fine sandy loam 0.2 inch to 1.5 inches thick; hard, friable; calcareous; moderately alkaline.

The solum ranges from 40 to 54 inches in thickness.

The A horizon is 3 to 13 inches thick. It is brown or reddish brown. It is silt loam, loam, or silty clay loam. This horizon is moderately alkaline and calcareous in most pedons, but in a few pedons it is slightly alkaline.

The Bw horizon is brown, reddish brown, or yellowish red. It is silt loam, silty clay loam, or clay loam.

The C horizon is reddish brown, light reddish brown, yellowish red, or red. It is very fine sandy loam, silt loam, loam, or silty clay loam.

Wichita Series

The Wichita series consists of very deep, well drained, moderately slowly permeable, nearly level and very gently sloping soils on stream terraces, low divides, and upland plains. These soils formed in loamy and clayey old alluvium, mainly derived from red-bed clays and shales. They are fine, mixed, thermic Typic Paleustalfs. Slopes range from 0 to 3 percent.

Typical pedon of Wichita clay loam, 1 to 3 percent slopes; from the intersection of State Highway 25 and State Highway 79 in Archer City, 2.7 miles west on State Highway 25, about 2.6 miles west on Farm Road 210, about 2.2 miles south and 1.5 miles west on Farm Road 2178, about 0.4 mile north on a ranch road, and 50 feet west in an area of rangeland (State plane coordinates 691,860 feet N., 1,622,270 feet E.):

A—0 to 7 inches; dark brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable; common fine and medium roots; few iron and manganese concretions 2 to 5 millimeters across; slightly alkaline; gradual smooth boundary.

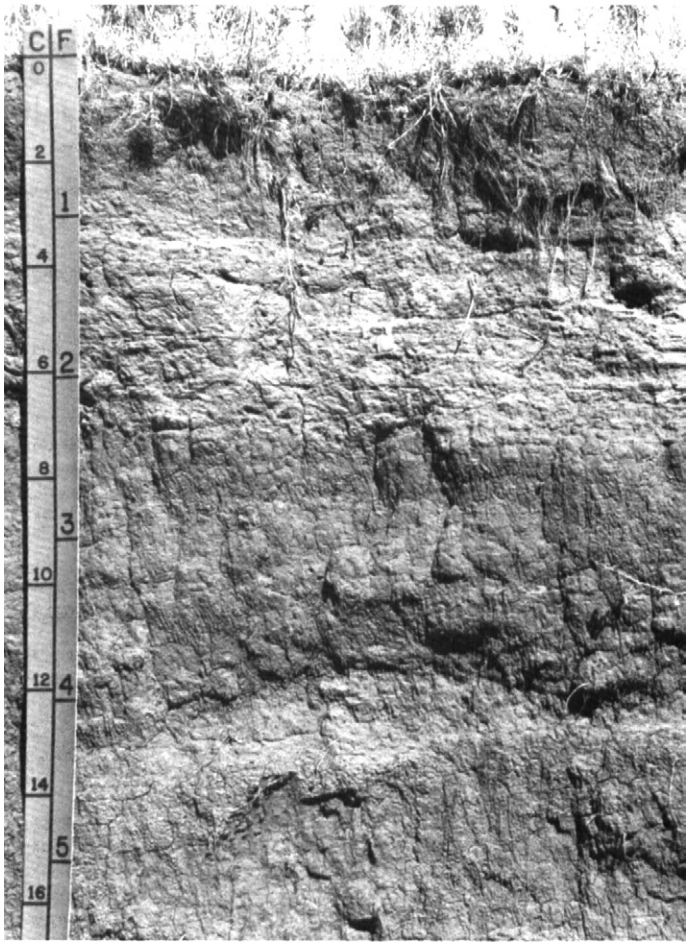

Figure 23.—A profile of Wheatwood silt loam, occasionally flooded. Stratification is most evident between depths of 12 and 30 inches.

Bt1—7 to 16 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; weak fine prismatic structure parting to moderate medium subangular blocky; firm, hard; common fine and medium roots; common thick continuous clay films on faces of peds; common iron and manganese concretions 2 to 5 millimeters across; few calcium carbonate concretions 1 to 5 millimeters across; calcareous; moderately alkaline; gradual smooth boundary.

Bt2—16 to 37 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium and coarse prismatic structure; very hard, very firm; few fine and medium roots; common thick continuous clay films on faces of peds; common iron and manganese concretions 1 to 5 millimeters across; few calcium carbonate concretions 1 to 5 millimeters across; calcareous; moderately alkaline; clear smooth boundary.

Btk—37 to 45 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium prismatic structure; very hard, very firm; few fine and medium roots; common thick continuous clay films on faces of peds; common iron and manganese concretions 2 to 10 millimeters across; many calcium carbonate concretions and soft masses 2 to 20 millimeters across; calcareous; moderately alkaline; gradual smooth boundary.

B't—45 to 60 inches; reddish brown (2.5YR 4/4) silty clay, dark reddish brown (2.5YR 3/4) moist; moderate medium blocky structure; extremely hard, very firm; common thin continuous clay films on faces of peds; common iron and manganese concretions 1 to 5 millimeters across; common black stains on faces of peds; few calcium carbonate concretions 1 to 15 millimeters across; calcareous; moderately alkaline; gradual smooth boundary.

C—60 to 80 inches; interlayered reddish brown (2.5YR 4/4) silty clay and light gray (5Y 7/2) silty shale; weak fine and medium platy structure parting to strong fine angular blocky; extremely hard; very firm; calcareous; moderately alkaline.

The thickness of the solum to silty and clayey red beds is 60 to more than 80 inches. The solum is slightly alkaline or moderately alkaline. It is calcareous except for in the A horizon. The depth to secondary carbonates ranges from 7 to 24 inches.

The A horizon is 7 to 11 inches thick. It is brown, dark brown, or reddish brown.

The B horizon is brown, reddish brown, yellowish red, or red. It is clay, clay loam, or silty clay. Accumulations of calcium carbonate occur as a few visible concretions to about 10 percent soft masses, by volume.

The C horizon generally is brown, reddish brown, yellowish red, or red. In some pedons it is interlayered with gray, light gray, greenish gray, or light greenish gray shale. It is clay, silty clay, clay loam, silty clay loam, or shale.

Windthorst Series

The Windthorst series consists of very deep, moderately well drained, moderately slowly permeable, gently sloping soils on erosional uplands. These soils formed in stratified, loamy and clayey sediments or in weakly cemented, sandstone bedrock. They are fine, mixed, thermic Udic Paleustalfs. Slopes range from 1 to 5 percent.

Typical pedon of Windthorst fine sandy loam, 1 to 5 percent slopes; from the intersection of State Highway 79 and State Highway 25 in Archer City, 9.3 miles south on State Highway 79, about 4.1 miles east on a gravel road, 2.5 miles south on a gravel road, and 200 feet west in an area of rangeland (State plane coordinates 645,667 feet N., 1,668,633 feet E.):

A—0 to 6 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure parting to weak medium granular; soft, very friable; many fine and medium roots; many fine pores; slightly acid; abrupt smooth boundary.

Bt1—6 to 10 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak fine prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; many fine and medium roots; common fine and few medium pores; common thin patchy clay films; slightly acid; gradual smooth boundary.

Bt2—10 to 15 inches; reddish brown (5YR 5/4) sandy clay, reddish brown (5YR 4/4) moist; moderate medium and coarse prismatic structure; hard, firm; common fine and few medium roots; common medium pores; many thick continuous clay films; few iron and manganese concretions 2 to 5 millimeters across; slightly acid; gradual smooth boundary.

Bt3—15 to 30 inches; reddish brown (5YR 5/4) sandy clay, reddish brown (5YR 4/4) moist; many medium and coarse mottles in shades of brown and red; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm; common fine and few medium and coarse roots; few medium pores; many thick continuous clay films; common iron and manganese concretions 2 to 10 millimeters across; neutral; gradual smooth boundary.

BC1—30 to 37 inches; mottled reddish brown (5YR 5/4), brown (7.5YR 5/4), red (2.5YR 4/6 and 4/8), and dark red (2.5YR 3/6) sandy clay loam; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm; few medium and coarse roots; common thick patchy clay films; common iron and manganese concretions 2 to 10 millimeters across; few white noncalcareous concretions 1 to 3 millimeters across; few sandstone pebbles less than 15 millimeters across; slightly alkaline; abrupt wavy boundary.

BC2—37 to 48 inches; mottled yellowish brown (10YR 6/6 and 6/8), reddish brown (5YR 4/4), red (2.5YR 4/8), and light gray (5Y 7/1) sandy clay; strata and pockets of light gray (5Y 7/1) shale; strong fine and medium angular blocky structure; extremely hard, very firm; few iron and manganese concretions 2 to 12 millimeters across; moderately alkaline; gradual smooth boundary.

C—48 to 80 inches; mottled yellowish brown (10YR 6/6 and 6/8), reddish brown (5YR 4/4), red (2.5YR 4/8), and light gray (5Y 7/1) sandy clay loam, clay loam, and shale; massive; extremely hard, very firm; moderately alkaline.

The thickness of the solum to red-bed material ranges from 40 to 55 inches. Sandstone pebbles, cobbles, and flagstones cover 0 to about 3 percent of the surface. The content of clay in the control section ranges from 35 to 45 percent.

The A horizon is 3 to 12 inches thick. It is brown, dark brown, or yellowish brown. It is moderately acid to neutral.

The upper part of the Bt horizon is reddish brown or yellowish red. It is clay, sandy clay, or clay loam. Reaction is slightly acid or moderately acid.

The lower part of the Bt horizon is reddish brown or yellowish red. It has medium or coarse mottles of strong brown, brown, light brown, yellowish brown, reddish brown, brownish yellow, reddish yellow, yellowish red, or red. It is clay, sandy clay, or clay loam. The content of clay is 30 to 45 percent. Reaction ranges from slightly acid to moderately alkaline.

The BC horizon is mottled in shades of brown, red, yellow, or gray. It is sandy clay, clay loam, or sandy clay loam. The content of clay is 30 to 45 percent. Reaction ranges from slightly acid to moderately alkaline.

The C horizon is sandy clay; shale that has a clayey texture; or weakly cemented, sandstone bedrock stratified with loamy or clayey material. Colors in shades of brown, red, yellow, or gray dominate the horizon or occur as strata or mottles.

Winters Series

The Winters series consists of very deep, well drained, moderately slowly permeable, nearly level and gently sloping soils on upland plains, divides, and old stream terraces (fig. 24). These soils formed in loamy or clayey alluvium. They are fine, mixed, thermic Typic Paleustalfs. Slopes range from 0 to 3 percent.

Typical pedon of Winters loam, 0 to 1 percent slopes; from the intersection of Farm Road 1954 and Farm Road 2650 about 5.5 miles east of Holliday, 0.2 miles west on Farm Road 1954, about 0.5 mile north on a

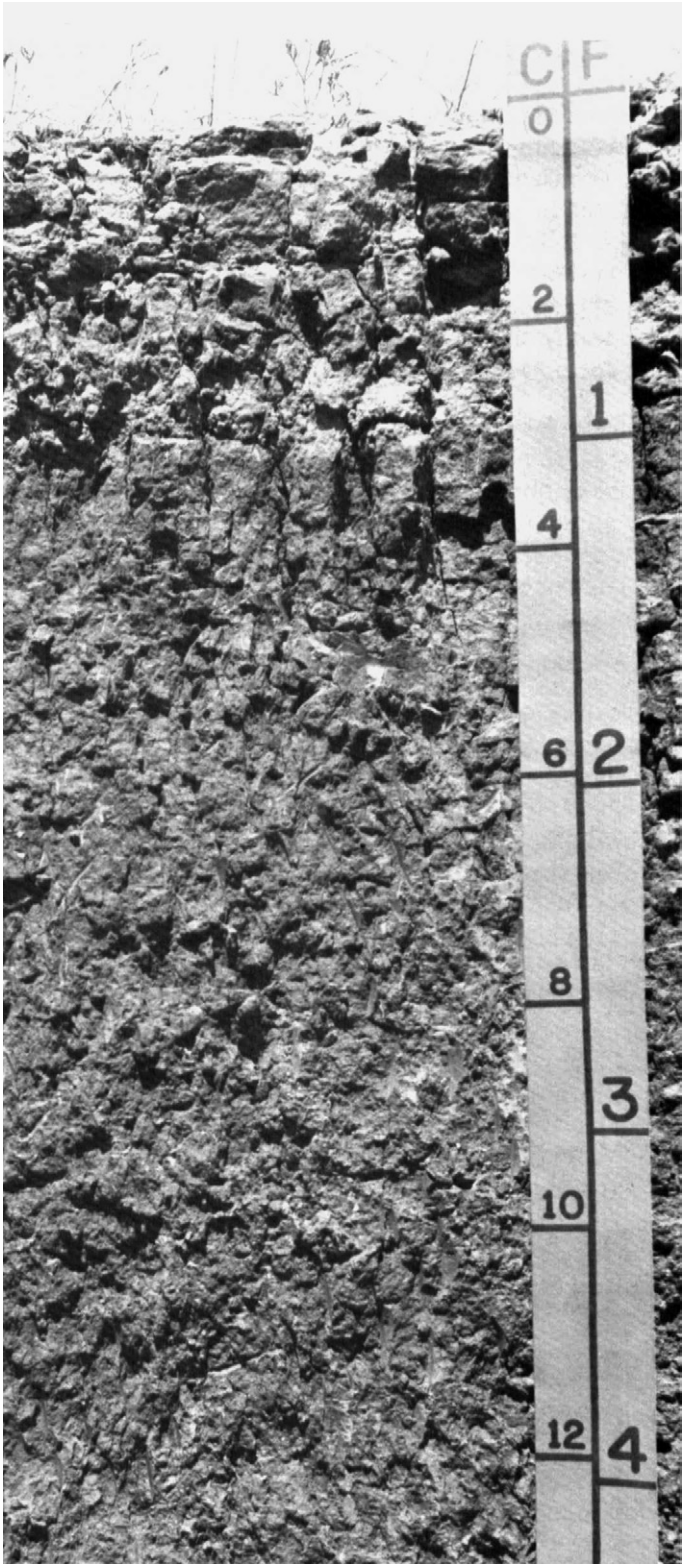

Figure 24.—A profile of Winters loam. Texture changes abruptly at a depth of 11 inches. Coarse prismatic structure is evident in the upper part of the B horizon.

gravel road, 0.2 mile east on a farm road, and 75 feet north in an area of rangeland (State plane coordinates 784,708 feet N., 1,659,308 feet E.):

A1—0 to 5 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, very firm; many fine and medium roots; common fine pores; slightly acid; clear smooth boundary.

A2—5 to 11 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; common fine roots; common fine and medium pores; slightly acid; abrupt smooth boundary.

Bt1—11 to 21 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/4) moist; strong coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm; few fine roots; common thick continuous clay films; slightly alkaline; clear smooth boundary.

Bt2—21 to 30 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm; few fine roots; common thick continuous clay films; moderately alkaline; gradual smooth boundary.

Btk—30 to 51 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak fine prismatic structure parting to moderate fine subangular blocky; very hard, firm; few fine roots; few fine and medium pores; common thick continuous clay films; common medium concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B't—51 to 68 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak fine prismatic structure parting to moderate fine subangular blocky; very hard, firm; few fine roots; common fine and medium pores; few medium concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C—68 to 80 inches; stratified yellowish red (5YR 5/6) and reddish yellow (5YR 6/8) sandy clay loam, yellowish red (5YR 4/6 and 5/8) moist; massive; hard, friable; many fine and medium pores; few medium concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The depth to carbonates ranges from 30 to 50 inches. Carbonates are few or common and generally occur as concretions.

The A horizon is 4 to 12 inches thick. It is reddish brown or brown. It is neutral or slightly alkaline.

The B horizon is reddish brown, dark reddish brown, red, or yellowish red. It is clay loam or clay. It is neutral to moderately alkaline.

The C horizon is yellowish red or reddish yellow. It is sandy clay loam or clay loam.

Yomont Series

The Yomont series consists of very deep, well drained, moderately rapidly permeable, nearly level soils on flood plains. These soils formed in calcareous, stratified, silty and loamy alluvium. They are coarse-silty, mixed (calcareous), thermic Typic Ustifluvents. Slopes are 0.5 to 1.5 percent.

Typical pedon of Yomont very fine sandy loam, occasionally flooded; from the intersection of Farm Road 2846 and U.S. Highway 82 in Dundee, 5.3 miles north on Farm Road 2846, about 0.6 mile west on a county road, and 50 feet north in an area of rangeland (State plane coordinates 785,983 feet N., 1,571,475 feet E.):

A—0 to 9 inches; reddish brown (2.5YR 5/4) very fine sandy loam, reddish brown (2.5YR 4/4) moist; weak medium granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt smooth boundary.

C1—9 to 13 inches; reddish brown (2.5YR 5/4) loamy very fine sand, reddish brown (2.5YR 4/4) moist; massive; soft, loose; thin strata of silt loam; evident bedding planes; common wormcasts; calcareous; moderately alkaline; clear smooth boundary.

C2—13 to 44 inches; reddish brown (2.5YR 5/4) very fine sandy loam, reddish brown (2.5YR 4/4) moist; weak medium granular structure; soft, very friable; strata of silt loam and silty clay loam 1 to 20 millimeters thick; bedding planes evident; calcareous; moderately alkaline; gradual smooth boundary.

C3—44 to 52 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; loose when dry or moist; strata of silt loam and very fine sandy loam 1 to 10 millimeters thick; distinct bedding planes; calcareous; moderately alkaline; gradual smooth boundary.

C4—52 to 84 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; moderate medium platy structure; soft, very friable; strata of silt loam and fine sandy loam 1 to 20 millimeters thick; distinct bedding planes; calcareous; moderately alkaline.

These soils are calcareous throughout.

The A horizon ranges from 7 to 10 inches in thickness. It is reddish brown or red.

The C horizon is reddish brown, light reddish brown, yellowish red, or red. It is dominantly very fine sandy loam with strata of loamy fine sand, fine sandy loam, loam, silt loam, or silty clay loam.

Formation of the Soils

Soil forms through the action and interaction of five major factors. These factors are parent material, climate, living organisms, relief, and time.

Several processes were involved in the formation of horizons in the soils of Archer County. The three main processes are accumulation of organic matter, leaching of calcium carbonates and bases, and formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

Accumulation of organic matter in the upper part of the profile, or the A horizon, of soils has been important in the county. The content of organic matter in the soils ranges from moderate to low.

Leaching of carbonates and bases has taken place in nearly all of the soils in the county. Generally, leaching of bases in soils precedes translocation of silicate clay minerals. Most of the soils are moderately leached to strongly leached. This leaching contributed to the development of horizons. Calcium carbonates have been leached from the upper horizons of most of the soils. However, the amount of rainfall in the county is not great enough to leach the carbonates entirely from the soils, and as a result, many of the soils have a layer in which calcium carbonates have accumulated.

In several of the soils in the county, the downward translocation of clay minerals has contributed to horizon development. The Bt horizon in the soils contains appreciably more silicate clay than the A horizon. The soils were probably leached of carbonates and soluble salts to a considerable extent before translocation of silicate clays took place. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils of Archer County. Deandale, Hollister, Kamay, and Rotan soils are examples of soils that have translocated silicate clays accumulated in the Bt horizon.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soils. Soils in Archer County formed in three kinds of parent material: red-bed material, old alluvium or outwash material, and recent alluvial material.

Soils that formed in red beds are extensive throughout the county. They include those that formed in clayey red beds, mainly the Aspermont, Hollister, Knoco, Tillman, and Vernon soils, and those that formed over sandstone or interbedded sandstone and clayey red beds, mainly the Bluegrove, Bonti, Darnell, Exray, Jolly, and Latom soils.

Soils that formed in old alluvial or outwash material are mainly in the northern part of the county. This mantle of outwash was deposited over the red beds during the Pliocene and Pleistocene periods. Grandfield soils developed in the sandier material. Rotan, Winters, Rowden, Wichita, Weswind, Windthorst, Kamay, and Deandale soils formed in the clayey old alluvial or outwash material.

Wheatwood, Westfork, Mangum, Port, Yomont, and Gracemore soils formed in recent alluvial material. They are on flood plains along streams throughout the county. The surface layer and subsurface layer of these soils vary in texture, and the soils are mostly stratified.

Climate

Winters are dry and summers are hot and humid in Archer County. The effect of the climate has been modified locally by relief and runoff. Because the amount of rainfall is low and because long, dry periods of weather occur, soil formation is slow. The soils in the county are seldom wet below their root zone. As a result, many of the soils have an accumulation of calcium carbonate in a horizon. Leaching has not removed free lime from the upper layers of Vernon, Aspermont, and other weakly formed soils.

Living Organisms

Plants, micro-organisms, earthworms, and other forms of animal life are important in the formation of soils. The kinds and amounts of plants are determined partly by the climate and parent material. The vegetation in the county is mostly grass but includes some brushy plants and small hardwoods. The grasses

are tall or short, depending on the kind of soil. The more sandy soils, such as Grandfield, Gracemore, and Yomont soils, support mid and tall grasses, while the more clayey soils, such Rotan, Hollister, and Tillman soils, support short grasses.

Prairie vegetation contributes large amounts of organic matter to the soil. Grass, leaves, and stems fall on the surface and decay, adding dark organic material to the surface. Roots decompose and distribute organic matter throughout the solum and provide food for earthworms and micro-organisms. Rodents offset the leaching of soluble minerals and destroy soil structure by mixing the soil material.

Human activities also have influenced soil formation. These activities include fencing land and then allowing it to be overgrazed, changing the kind of vegetation that is grown, and clearing and plowing the soils for crops. In addition, crops have been clean harvested and the accompanying runoff and wind erosion have not been controlled. As a result, organic matter has been depleted and silt and clay particles have been eroded from the plow layer. The operation of heavy machinery and untimely tillage of the soils have resulted in compaction of the soils and a slower rate of infiltration of water and air.

Relief

Relief affects soil formation through its influence on drainage, erosion, vegetation, soil temperature, and runoff. If other factors of soil formation are equal, the degree of profile development depends on the amount of water that enters a soil. For example, Vernon and Aspermont soils, which are on sloping uplands, absorb less moisture and normally have a less well defined profile than Tillman soils, which are on nearly level flats in the uplands. The formation of soils in areas where the slope is steep is retarded by continuous erosion.

On steep soils, if the parent material is sandstone or shale, geologic erosion occurs almost as fast as the soil material is formed. An example is the shallow Jolly soils, which have been forming as long as the less sloping Bluegrove soils but are shallower.

Relief also affects the kind and amount of vegetation on a soil. Soils on north-facing slopes receive less sunlight than those on south-facing slopes; consequently, they lose less moisture through evaporation. Because they have more moisture available, the soils on the north-facing slopes have denser vegetation than those on the south-facing slopes and generally are more strongly developed. For the same reason, the soils on east-facing slopes are more strongly developed than those on west-facing slopes.

Time

Generally, a long time is required for the formation of soils with distinct horizons. The differences in length of time that parent material has been in place are commonly reflected in the degree of development of the soil profile.

The soils in Archer County range in age from young to old. The young soils have very little profile development, and the older soils have well developed, distinct horizons. Yomont soils are an example of young soils, and Kamay soils are an example of the older soils that have well developed horizons.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively

drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salt (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant that is not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3

inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the plants that are the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net

irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential climax vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Surface layer. Technically, the A horizon in mineral soils. Generally refers to the uppermost mineral layer of soil. Includes the Ap horizon or "plow layer."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). An otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Archer City, Texas)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	53.2	28.3	40.8	81	5	64	1.01	0.10	1.68	2	1.5
February	58.9	32.6	45.8	86	11	80	1.37	.61	2.03	3	1.2
March	67.6	40.8	54.2	91	16	228	1.66	.51	2.59	3	.7
April	78.0	52.2	65.1	96	31	453	2.97	.85	4.67	4	.0
May	84.0	58.9	71.5	101	40	667	3.92	2.04	5.55	6	.0
June	92.3	68.0	80.2	105	53	906	2.62	1.21	3.82	4	.0
July	98.0	72.4	85.2	107	61	1,091	2.01	.43	3.25	3	.0
August	95.3	70.5	82.9	106	60	1,020	2.24	.60	3.57	4	.0
September	87.0	63.4	75.2	101	45	756	4.12	1.05	6.55	5	.0
October	77.9	51.9	64.9	96	34	462	3.09	.92	4.87	4	.0
November	66.1	41.4	53.8	87	21	185	1.78	.54	2.80	3	.5
December	58.8	32.9	45.9	82	10	39	1.20	.27	1.93	2	.4
Yearly:											
Average	76.4	51.1	63.8	---	---	---	---	---	---	---	---
Extreme	---	---	---	108	5	---	---	---	---	---	---
Total	---	---	---	---	---	5,951	27.99	21.56	33.98	43	4.3

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Archer City, Texas)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Mar. 19	Apr. 1	Apr. 8
2 years in 10 later than--	Mar. 13	Mar. 26	Apr. 4
5 years in 10 later than--	Feb. 28	Mar. 15	Mar. 27
First freezing temperature in fall:			
1 year in 10 earlier than--	Nov. 13	Nov. 8	Oct. 27
2 years in 10 earlier than--	Nov. 22	Nov. 14	Nov. 2
5 years in 10 earlier than--	Dec. 8	Nov. 25	Nov. 12

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Archer City, Texas)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	255	232	212
8 years in 10	265	239	218
5 years in 10	282	254	229
2 years in 10	300	269	241
1 year in 10	309	277	246

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AsC3	Aspermont clay loam, 1 to 5 percent slopes, eroded	7,940	1.3
Ba	Badland	260	*
BeB	Bluegrove fine sandy loam, 1 to 5 percent slopes	64,710	10.9
BtC	Bonti fine sandy loam, 1 to 5 percent slopes	6,220	1.0
DaD	Darnell-Exray complex, 2 to 15 percent slopes, stony	7,150	1.2
DeA	Deandale loam, 0 to 1 percent slopes	2,810	0.5
DeB	Deandale loam, 1 to 3 percent slopes	12,360	2.1
DnA	Deandale silt loam, 0 to 1 percent slopes	17,050	2.9
DnB	Deandale silt loam, 1 to 3 percent slopes	2,100	0.4
DsA	Deandale silt loam, loamy substratum, 0 to 1 percent slopes	6,670	1.1
Gm	Gracemore fine sandy loam, frequently flooded	140	*
GrC	Grandfield fine sandy loam, 1 to 5 percent slopes	14,840	2.5
HoA	Hollister silty clay loam, 0 to 1 percent slopes	5,310	0.9
HoB	Hollister silty clay loam, 1 to 3 percent slopes	320	0.1
JoC	Jolly-Rock outcrop complex, 2 to 12 percent slopes, stony	40,240	6.8
KaA	Kamay silt loam, 0 to 1 percent slopes	23,000	3.9
KaB	Kamay silt loam, 1 to 3 percent slopes	44,860	7.6
KDA	Kamay-Deandale association, saline, 0 to 2 percent slopes	910	0.2
KvD	Knoco-Vernon complex, 2 to 12 percent slopes	13,860	2.3
KvE	Knoco-Vernon complex, 10 to 45 percent slopes, very bouldery	23,000	3.9
Ma	Mangum clay, occasionally flooded	8,430	1.4
Mc	Mangum clay, frequently flooded	4,600	0.8
Mw	Mangum-Wheatwood complex, occasionally flooded	17,890	3.0
Ow	Oil-waste land	4,530	0.8
Po	Port-Wheatwood complex, occasionally flooded	16,370	2.8
Pw	Port and Wheatwood soils, frequently flooded	27,000	4.6
RoA	Rotan silty clay loam, 0 to 1 percent slopes	8,570	1.4
RoB	Rotan silty clay loam, 1 to 3 percent slopes	2,870	0.5
RwB	Rowden clay loam, 1 to 3 percent slopes	860	0.1
TcA	Tillman clay loam, 0 to 1 percent slopes	14,240	2.4
TcB	Tillman clay loam, 1 to 3 percent slopes	36,960	6.2
VeC	Vernon clay, 1 to 5 percent slopes	20,730	3.5
VkD	Vernon-Knoco complex, 2 to 8 percent slopes	27,220	4.6
VlD	Vernon-Latom complex, 3 to 12 percent slopes, stony	1,700	0.3
Wc	Westfork silty clay, occasionally flooded	2,050	0.3
WdC	Weswind fine sandy loam, 1 to 5 percent slopes	19,900	3.4
We	Wheatwood silt loam, occasionally flooded	17,660	3.0
WhA	Wichita clay loam, 0 to 1 percent slopes	2,210	0.4
WhB	Wichita clay loam, 1 to 3 percent slopes	10,210	1.7
WlC	Windthorst fine sandy loam, 1 to 5 percent slopes	7,680	1.3
WnA	Winters loam, 0 to 1 percent slopes	19,620	3.3
WnB	Winters loam, 1 to 3 percent slopes	15,630	2.6
Yo	Yomont very fine sandy loam, occasionally flooded	1,310	0.2
	Water areas more than than 40 acres in size	10,720	1.8
	Total	592,710	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
BeB	Bluegrove fine sandy loam, 1 to 5 percent slopes (where irrigated)
BtC	Bonti fine sandy loam, 1 to 5 percent slopes (where irrigated)
DeA	Deandale loam, 0 to 1 percent slopes
DeB	Deandale loam, 1 to 3 percent slopes
DnA	Deandale silt loam, 0 to 1 percent slopes
DnB	Deandale silt loam, 1 to 3 percent slopes
DsA	Deandale silt loam, loamy substratum, 0 to 1 percent slopes
GrC	Grandfield fine sandy loam, 1 to 5 percent slopes (where irrigated)
HoA	Hollister silty clay loam, 0 to 1 percent slopes
HoB	Hollister silty clay loam, 1 to 3 percent slopes
KaA	Kamay silt loam, 0 to 1 percent slopes
KaB	Kamay silt loam, 1 to 3 percent slopes
Ma	Mangum clay, occasionally flooded
Mw	Mangum-Weswood complex, occasionally flooded
Po	Port-Weswood complex, occasionally flooded
RoA	Rotan silty clay loam, 0 to 1 percent slopes
RoB	Rotan silty clay loam, 1 to 3 percent slopes
RwB	Rowden clay loam, 1 to 3 percent slopes
TcA	Tillman clay loam, 0 to 1 percent slopes
TcB	Tillman clay loam, 1 to 3 percent slopes
Wc	Westfork silty clay, occasionally flooded
WdC	Weswind fine sandy loam, 1 to 5 percent slopes (where irrigated)
We	Wheatwood silt loam, occasionally flooded
WhA	Wichita clay loam, 0 to 1 percent slopes
WhB	Wichita clay loam, 1 to 3 percent slopes
WlC	Windthorst fine sandy loam, 1 to 5 percent slopes (where irrigated)
WnA	Winters loam, 0 to 1 percent slopes
WnB	Winters loam, 1 to 3 percent slopes
Yo	Yomont very fine sandy loam, occasionally flooded

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Wheat	Cotton lint	Sorghum hay
		Bu	Lbs	Tons
AsC3---------- Aspermont	IVe	15	150	2.5
Ba*---------- Badland	VIIIe	---	---	---
BeB---------- Bluegrove	IIIe	25	225	4.5
BtC---------- Bonti	IIIe	25	250	4.0
DaD---------- Darnell-Exray	VIIs	---	---	---
DeA---------- Deandale	IIs	30	300	4.5
DeB---------- Deandale	IIIe	25	275	4.0
DnA---------- Deandale	IIs	30	300	4.5
DnB---------- Deandale	IIIe	25	275	4.0
DsA---------- Deandale	IIs	30	300	4.5
Gm---------- Gracemore	Vw	---	---	---
GrC---------- Grandfield	IIIe	30	250	4.5
HoA---------- Hollister	IIc	30	325	---
HoB---------- Hollister	IIe	25	300	4.0
JoC*---------- Jolly-Rock outcrop	VIs	---	---	---
KaA---------- Kamay	IIs	25	250	4.5
KaB---------- Kamay	IIIe	20	225	---
KDA*:				
Kamay----------	VIs	---	---	4.0
Deandale----------	VIs	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Wheat	Cotton lint	Sorghum hay
		Bu	Lbs	Tons
KvD, KvE---------- Knoco-Vernon	VIIs	---	---	---
Ma---------- Mangum	IIIw	20	---	3.0
Mc---------- Mangum	Vw	---	---	---
Mw---------- Mangum-Wheatwood	IIIw	20	400	4.0
Ow*---------- Oil-waste land	VIIIs	---	---	---
Po---------- Port-Wheatwood	IIw	30	400	5.0
Pw---------- Port and Wheatwood	Vw	---	---	---
RoA---------- Rotan	IIc	30	375	5.0
RoB---------- Rotan	IIe	25	350	4.5
RwB---------- Rowden	IIIe	20	300	3.5
TcA---------- Tillman	IIs	30	300	4.5
TcB---------- Tillman	IIIe	25	275	4.0
VeC---------- Vernon	IVe	15	---	2.0
VkD---------- Vernon-Knoco	VIe	---	---	---
VlD---------- Vernon-Latom	VIIs	---	---	---
Wc---------- Westfork	IIIw	15	200	3.5
WdC---------- Weswind	IIIe	20	---	4.5
We---------- Wheatwood	IIw	30	350	5.5
WhA---------- Wichita	IIc	30	300	4.5
WhB---------- Wichita	IIe	25	275	4.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Wheat	Cotton lint	Sorghum hay
		Bu	Lbs	Tons
WlC---------- Windthorst	IIIe	20	---	4.0
WnA---------- Winters	IIc	30	300	4.5
WnB---------- Winters	IIe	25	250	4.0
Yo---------- Yomont	IIw	30	350	5.0

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
AsC3 Aspermont	Clay Loam	2,400	1,600	1,200
BeB Bluegrove	Tight Sandy Loam	3,500	2,800	2,200
BtC Bonti	Sandy Loam	6,000	3,500	3,000
DaD*:				
Darnell	Sandstone Hill	3,200	2,100	1,400
Exray	Sandstone Hill	6,000	3,500	2,500
DeA, DeB, DnA, DnB, DsA Deandale	Claypan Prairie	2,800	2,200	1,600
Gm Gracemore	Sandy Bottomland	9,000	7,800	7,000
GrC Grandfield	Sandy Loam	4,000	2,800	2,000
HoA, HoB Hollister	Clay Loam	2,400	1,800	1,200
JoC*:				
Jolly	Sandstone Hill	3,000	2,500	1,500
Rock outcrop.				
KaA, KaB Kamay	Claypan Prairie	2,700	2,100	1,500
KDA*:				
Kamay	Saline	1,000	500	0
Deandale	Saline	1,000	500	0
KvD*, KvE*:				
Knoco	Very Shallow Clay	1,400	1,000	600
Vernon	Shallow Clay	2,500	1,700	1,000
Ma Mangum	Clayey Bottomland	3,000	2,250	1,500
Mc Mangum	Clayey Bottomland	3,000	2,250	1,500
Mw*:				
Mangum	Clayey Bottomland	3,000	2,250	1,500
Wheatwood	Loamy Bottomland	8,000	6,500	5,000
Po*:				
Port	Draw	7,000	4,900	3,500
Wheatwood	Loamy Bottomland	8,000	6,500	5,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Pw*:				
Port	Draw	7,000	4,900	3,500
Wheatwood	Loamy Bottomland	8,000	6,500	5,000
RoA, RoB Rotan	Clay Loam	2,500	2,000	1,500
RwB Rowden	Clay Loam	4,500	3,500	2,500
TcA, TcB Tillman	Clay Loam	2,200	1,700	1,200
VeC Vernon	Shallow Clay	2,500	1,700	1,000
VkD*:				
Vernon	Shallow Clay	2,500	1,700	1,000
Knoco	Very Shallow Clay	1,400	1,000	600
VlD*:				
Vernon	Shallow Clay	2,500	1,700	1,000
Latom	Very Shallow	900	600	400
Wc Westfork	Clayey Bottomland	4,500	3,500	2,500
WdC Weswind	Tight Sandy Loam	3,500	2,700	2,000
We Wheatwood	Loamy Bottomland	8,000	6,500	5,000
WhA, WhB Wichita	Clay Loam	2,600	2,000	1,400
WlC Windthorst	Tight Sandy Loam	6,000	4,500	3,000
WnA, WnB Winters	Clay Loam	2,500	2,200	1,200
Yo Yomont	Loamy Bottomland	3,600	2,700	1,750

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways	Off-road motorcycle trails
AsC3 Aspermont	Slight	Slight	Moderate: slope.	Slight	Slight	Severe: fragile.
Ba* Badland	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: droughty, slope, thin layer.	Severe: too clayey, slope, fragile.
BeB Bluegrove	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.	Slight.
BtC Bonti	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.	Slight.
DaD*: Darnell	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Moderate: large stones.	Severe: depth to rock.	Moderate: large stones.
Exray	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: depth to rock.	Moderate: large stones.
DeA, DeB, DnA, DnB, DsA Deandale	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight	Moderate: dusty.
Gm Gracemore	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.	Moderate: flooding.
GrC Grandfield	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.
HoA Hollister	Slight	Slight	Slight	Slight	Slight	Slight.
HoB Hollister	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways	Off-road motorcycle trails
JoC*:						
Jolly	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: depth to rock.	Moderate: large stones.
Rock outcrop	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: depth to rock.	---
KaA	Slight	Slight	Slight	Slight	Slight	Moderate:
Kamay						dusty.
KaB	Slight	Slight	Moderate:	Slight	Slight	Moderate:
Kamay			slope.			dusty.
KDA*:						
Kamay	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight	Severe: excess salt, excess sodium, droughty.	Moderate: dusty.
Deandale	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: erodes easily.	Severe: excess salt, excess sodium, droughty.	Moderate: dusty.
KvD*:						
Knoco	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.	Severe: droughty, too clayey.	Severe: erodes easily.
Vernon	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Slight	Severe: too clayey.	Severe: erodes easily.
KvE*:						
Knoco	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: slope.	Severe: slope, too clayey, droughty.	Severe: erodes easily, slope, fragile.
Vernon	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: large stones, slope, fragile.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Gold fairways	Off-road motorcycle trails
Ma Mangum	Severe: flooding.	Moderate: too clayey, percs slowly.	Moderate: too clayey, flooding, percs slowly.	Moderate: too clayey.	Moderate: flooding.	Slight.
Mc Mangum	Severe: flooding.	Moderate: flooding, too clayey, percs slowly.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.	Moderate: flooding.
Mw*: Mangum	Severe: flooding.	Moderate: too clayey, percs slowly.	Moderate: too clayey, flooding, percs slowly.	Moderate: too clayey.	Moderate: flooding.	Slight.
Wheatwood	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.	Slight.
Ow* Oil-waste land	Severe: excess salt, dusty.	Severe: excess salt, dusty.	Severe: excess salt, dusty.	Moderate: dusty.	Severe: excess salt.	Moderate: dusty.
Po*: Port	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.	Slight.
Wheatwood	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.	Slight.
Pw*: Port	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Wheatwood	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
RoA Rotan	Slight	Slight	Slight	Slight	Slight	Slight.
RoB Rotan	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways	Off-road motorcycle trails
RwB Rowden	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.	Slight.
TcA Tillman	Slight	Slight	Slight	Slight	Slight	Slight.
TcB Tillman	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.
VeC Vernon	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
VkD*: Vernon	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey, erodes easily.
Knoco	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: droughty, depth to rock.	Moderate: too clayey, erodes easily.
VlD*: Vernon	Moderate: percs slowly, too clayey, slope.	Moderate: too clayey, percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
Latom	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: depth to rock.	Moderate: erodes easily.
Wc Westfork	Severe: flooding.	Moderate: too clayey, percs slowly.	Moderate: too clayey, flooding, percs slowly.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
WdC Weswind	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways	Off-road motorcycle trails
We Wheatwood	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.	Slight.
WhA Wichita	Slight	Slight	Slight	Slight	Slight	Slight.
WhB Wichita	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.
WlC Windthorst	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.
WnA Winters	Slight	Slight	Slight	Slight	Slight	Slight.
WnB Winters	Slight	Slight	Moderate: slope.	Slight	Slight	Slight.
Yo Yomont	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.	Moderate: dusty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Openland wildlife	Rangeland wildlife
AsC3---------- Aspermont	Fair	Good	Fair	Fair	Fair	Fair.
Ba*---------- Badland	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
BeB---------- Bluegrove	Fair	Good	Good	Fair	Good	Fair.
BtC---------- Bonti	Fair	Good	Good	Good	Good	Good.
DaD*:						
Darnell----------	Very poor	Very poor	Fair	Fair	Poor	Fair.
Exray----------	Very poor	Very poor	Fair	Fair	Poor	Fair.
DeA, DeB, DnA, DnB, DsA---------- Deandale	Good	Good	Poor	Poor	Fair	Poor.
Gm---------- Gracemore	Poor	Fair	Fair	Good	Fair	Fair.
GrC---------- Grandfield	Good	Good	Good	Good	Good	Good.
HoA, HoB---------- Hollister	Good	Good	Fair	Fair	Good	Fair.
JoC*:						
Jolly----------	Poor	Fair	Fair	Fair	Fair	Fair.
Rock outcrop.						
KaA, KaB---------- Kamay	Good	Good	Fair	Fair	Good	Fair.
KDA*:						
Kamay----------	Poor	Poor	Poor	Poor	Poor	Poor.
Deandale----------	Poor	Poor	Very poor	Very poor	Poor	Very poor.
KvD*:						
Knoco----------	Very poor	Very poor	Poor	Very poor	Very poor	Very poor.
Vernon----------	Fair	Fair	Poor	Fair	Fair	Fair.
KvE*:						
Knoco----------	Very poor	Very poor	Poor	Poor	Very poor	Poor.
Vernon----------	Very poor	Very poor	Poor	Fair	Very poor	Poor.
Ma---------- Mangum	Good	Good	Fair	Fair	Good	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Openland wildlife	Rangeland wildlife
Mc---------- Mangum	Poor	Fair	Poor	Fair	Poor	Poor.
Mw*:						
Mangum----------	Good	Good	Fair	Fair	Good	Fair.
Wheatwood---------	Good	Good	Fair	Good	Good	Fair.
Ow*---------- Oil-waste land	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Po*:						
Port----------	Good	Good	Good	Good	Good	Good.
Wheatwood---------	Good	Good	Fair	Good	Good	Fair.
Pw*:						
Port----------	Poor	Fair	Fair	Good	Fair	Fair.
Wheatwood---------	Poor	Good	Fair	Good	Fair	Fair.
RoA, RoB---------- Rotan	Good	Good	Fair	Good	Good	Fair.
RwB---------- Rowden	Fair	Good	Good	Good	Good	Good.
TcA, TcB---------- Tillman	Good	Good	Fair	Fair	Good	Fair.
VeC---------- Vernon	Fair	Fair	Poor	Fair	Fair	Fair.
VkD*:						
Vernon----------	Fair	Fair	Poor	Fair	Fair	Fair.
Knoco----------	Very poor	Very poor	Poor	Very poor	Very poor	Very poor.
VlD*:						
Vernon----------	Fair	Fair	Poor	Fair	Fair	Fair.
Latom----------	Very poor	Very poor	Fair	Fair	Poor	Fair.
Wc---------- Westfork	Fair	Fair	Poor	Fair	Fair	Poor.
WdC---------- Weswind	Fair	Good	Good	Fair	Good	Good.
We---------- Wheatwood	Good	Good	Fair	Good	Good	Fair.
WhA, WhB---------- Wichita	Good	Good	Fair	Fair	Good	Fair.
WlC---------- Windthorst	Fair	Good	Good	Good	Good	Good.
WnA, WnB---------- Winters	Good	Good	Good	Good	Good	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Openland wildlife	Rangeland wildlife
Yo---------- Yomont	Good	Good	Good	Good	Good	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AsC3--Aspermont	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Ba*--Badland	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: droughty, slope, too clayey.
BeB--Bluegrove	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: depth to rock.
BtC--Bonti	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Moderate: depth to rock.
DaD*:						
Darnell	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.
Exray	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock.
DeA, DeB, DnA, DnB, DsA--Deandale	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Gm--Gracemore	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
GrC--Grandfield	Slight	Slight	Slight	Slight	Slight	Slight.
HoA, HoB--Hollister	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
JoC*:						
Jolly	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
Rock outcrop	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
KaA, KaB--Kamay	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
KDA*:						
Kamay	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: excess salt, excess sodium, droughty.
Deandale	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: excess salt, excess sodium, droughty.
KvD*:						
Knoco	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: droughty, too clayey.
Vernon	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
KvE*:						
Knoco	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope, too clayey, droughty.
Vernon	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope, too clayey.
Ma Mangum	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: flooding.
Mc Mangum	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding, too clayey.
Mw*:						
Mangum	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: flooding.
Wheatwood	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Ow* Oil-waste land	Variable	Variable	Variable	Variable	Variable	Severe: excess salt.
Po*:						
Port	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Wheatwood	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Pw*:						
Port	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
Wheatwood	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
RoA, RoB	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Rotan						
RwB	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: depth to rock.
Rowden						
TcA, TcB	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
Tillman						
VeC	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Vernon						
VkD*:						
Vernon	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Knoco	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: droughty, too clayey.
VlD*:						
Vernon	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Latom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, droughty.
Wc	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: too clayey.
Westfork						
WdC	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Weswind						
We	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Wheatwood						
WhA, WhB	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Wichita						
WlC	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Windthorst						

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
WnA, WnB---------- Winters	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Yo---------- Yomont	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AsC3 Aspermont	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ba* Badland	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: too clayey, slope.
BeB Bluegrove	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
BtC Bonti	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
DaD*: Darnell	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
Exray	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, large stones.
DeA Deandale	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
DeB Deandale	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
DnA Deandale	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
DnB Deandale	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
DsA Deandale	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Gm Gracemore	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
GrC Grandfield	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HoA Hollister	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
HoB Hollister	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
JoC*: Jolly	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
KaA Kamay	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
KaB Kamay	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
KDA*: Kamay	Severe: percs slowly.	Slight	Severe: too clayey, excess sodium, excess salt.	Slight	Poor: too clayey, hard to pack, excess salt.
Deandale	Severe: percs slowly.	Slight	Severe: too clayey, excess sodium, excess salt.	Slight	Poor: too clayey, hard to pack, excess salt.
KvD*: Knoco	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: hard to pack, too clayey.
Vernon	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
KvE*: Knoco	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: hard to pack, slope, too clayey.
Vernon	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Ma, Mc Mangum	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Mw*:					
Mangum	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Wheatwood	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Ow* Oil-waste land	Variable	Variable	Severe: excess salt.	Variable	Poor: excess salt.
Po*, Pw*:					
Port	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Wheatwood	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
RoA Rotan	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
RoB Rotan	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
RwB Rowden	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
TcA Tillman	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
TcB Tillman	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
VeC Vernon	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
VkD*:					
Vernon	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Knoco	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: depth to rock, hard to pack, too clayey.
VlD*:					
Vernon	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VlD*: Latom	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Wc Westfork	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
WdC Weswind	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
We Wheatwood	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
WhA Wichita	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
WhB Wichita	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
WlC Windthorst	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
WnA Winters	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
WnB Winters	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Yo Yomont	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AsC3 Aspermont	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Ba* Badland	Poor: thin layer, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer, slope.
BeB Bluegrove	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BtC Bonti	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
DaD*: Darnell	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
Exray	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
DeA, DeB, DnA, DnB, DsA Deandale	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Gm Gracemore	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
GrC Grandfield	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
HoA, HoB Hollister	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
JoC*: Jolly	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, thin layer.
Rock outcrop	Poor: depth to rock.	---	---	Poor: depth to rock.
KaA, KaB Kamay	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
KDA*:				
Kamay	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Deandale	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium, too clayey.
KvD*:				
Knoco	Poor: thin layer, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, too clayey.
Vernon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
KvE*:				
Knoco	Poor: thin layer, shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, too clayey, slope.
Vernon	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Ma, Mc Mangum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mw*:				
Mangum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Wheatwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ow* Oil-waste land	Poor: thin layer, low strength.	Severe: excess fines.	Severe: excess fines.	Poor: excess salt, excess sodium.
Po*, Pw*:				
Port	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Wheatwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
RoA, RoB Rotan	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
RwB Rowden	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
TcA, TcB Tillman	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
VeC Vernon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
VkD*: Vernon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Knoco	Poor: thin layer, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, too clayey.
VlD*: Vernon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones.
Latom	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, large stones, depth to rock.
Wc Westfork	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
WdC Weswind	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
We Wheatwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
WhA, WhB Wichita	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
WlC Windthorst	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
WnA, WnB Winters	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Yo Yomont	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways
AsC3 Aspermont	Moderate: seepage.	Moderate: piping.	Erodes easily	Erodes easily.
Ba* Badland	Severe: slope.	Severe: thin layer.	Slope, erodes easily, percs slowly.	Slope, erodes easily, droughty.
BeB Bluegrove	Moderate: depth to rock.	Severe: thin layer.	Depth to rock	Depth to rock.
BtC Bonti	Moderate: depth to rock.	Severe: thin layer.	Depth to rock, erodes easily, soil blowing.	Erodes easily, depth to rock.
DaD*: Darnell	Severe: depth to rock, slope, seepage.	Severe: piping, thin layer.	Slope, depth to rock.	Slope, depth to rock.
Exray	Severe: depth to rock.	Severe: thin layer.	Slope, depth to rock.	Slope, depth to rock.
DeA, DeB, DnA, DnB, DsA Deandale	Slight	Slight	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Gm Gracemore	Severe: seepage.	Severe: seepage, piping, wetness.	Wetness, too sandy, soil blowing.	Wetness, droughty.
GrC Grandfield	Severe: seepage.	Severe: piping.	Soil blowing	Favorable.
HoA, HoB Hollister	Slight	Moderate: hard to pack.	Percs slowly	Percs slowly.
JoC*: Jolly	Severe: depth to rock.	Severe: thin layer.	Large stones, depth to rock.	Large stones, depth to rock.
Rock outcrop	Severe: depth to rock.	---	Depth to rock	Depth to rock.
KaA, KaB Kamay	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
KDA*: Kamay	Slight	Moderate: hard to pack, excess salt, excess sodium.	Erodes easily, percs slowly.	Erodes easily, percs slowly, excess salt, excess sodium.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways
KDA*:				
Deandale	Slight	Severe: excess sodium, excess salt.	Erodes easily, percs slowly.	Excess salt, excess sodium, erodes easily.
KvD*:				
Knoco	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, too arid.
Vernon	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, droughty.
KvE*:				
Knoco	Severe: slope.	Moderate: hard to pack, large stones.	Slope, percs slowly, erodes easily, large stones.	Too arid, slope, droughty.
Vernon	Severe: slope.	Moderate: hard to pack, large stones.	Slope, erodes easily, percs slowly, large stones.	Slope, erodes easily, droughty, large stones.
Ma, Mc Mangum	Slight	Severe: hard to pack.	Percs slowly	Percs slowly.
Mw*:				
Mangum	Slight	Severe: hard to pack.	Percs slowly	Percs slowly.
Wheatwood	Moderate: seepage.	Severe: piping.	Erodes easily	Erodes easily.
Ow* Oil-waste land	Variable	Severe: excess salt.	Variable	Excess salt.
Po*, Pw*:				
Port	Moderate: seepage.	Moderate: piping.	Favorable	Favorable.
Wheatwood	Moderate: seepage.	Severe: piping.	Erodes easily	Erodes easily.
RoA, RoB Rotan	Moderate: seepage.	Moderate: hard to pack.	Favorable	Favorable.
RwB Rowden	Moderate: depth to rock.	Severe: thin layer.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
TcA, TcB Tillman	Slight	Moderate: hard to pack.	Percs slowly	Percs slowly.
VeC Vernon	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, droughty.
VkD*:				
Vernon	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, droughty.
Knoco	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, too arid.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways
VlD*:				
Vernon	Slight	Moderate: hard to pack.	Erodes easily, percs slowly.	Erodes easily, droughty.
Latom	Severe: depth to rock.	Severe: thin layer.	Depth to rock	Depth to rock.
Wc Westfork	Slight	Moderate: hard to pack.	Percs slowly	Percs slowly.
WdC Weswind	Slight	Moderate: piping, hard to pack.	Favorable	Favorable.
We Wheatwood	Moderate: seepage.	Severe: piping.	Erodes easily, soil blowing.	Erodes easily.
WhA, WhB Wichita	Slight	Slight	Favorable	Favorable.
WlC Windthorst	Slight	Moderate: hard to pack, piping.	Erodes easily, soil blowing.	Erodes easily.
WnA, WnB Winters	Moderate: seepage.	Moderate: hard to pack.	Favorable	Favorable.
Yo Yomont	Severe: seepage.	Severe: piping.	Erodes easily, soil blowing.	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
AsC3---------- Aspermont	0-7	Clay loam--------	CL	A-6, A-7-6	0	90-100	85-100	85-100	65-95	30-45	15-28
	7-40	Clay loam, silty clay loam.	CL	A-6, A-7-6	0	98-100	90-100	85-100	65-95	30-45	15-28
	40-80	Clay loam, silty clay loam.	CL	A-6, A-7-6	0	98-100	90-100	85-100	65-95	30-45	15-28
Ba*---------- Badland	0-40	Variable---------	---	---	---	---	---	---	---	---	---
BeB---------- Bluegrove	0-8	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-2, A-4, A-6	0	100	98-100	70-100	30-65	<30	NP-14
	8-29	Clay loam, clay, sandy clay.	CL	A-6, A-7	0-5	95-100	95-100	90-100	51-80	28-50	11-30
	29-45	Weathered bedrock	---	---	---	---	---	---	---	---	---
BtC---------- Bonti	0-7	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2-4	0-2	90-100	90-100	70-100	25-70	<30	NP-10
	7-35	Sandy clay, sandy clay loam.	CL, SC	A-6, A-7	0-4	80-100	80-100	70-100	38-75	26-45	13-25
	35-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
DaD*:											
Darnell---------	0-4	Extremely stony fine sandy loam.	SM, SC, ML, CL	A-4, A-2	15-30	90-100	90-100	85-100	30-60	<30	NP-10
	4-11	Fine sandy loam, loam, gravelly fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0-10	70-100	70-100	60-100	25-60	<30	NP-10
	11-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Exray----------	0-5	Stony fine sandy loam.	SC-SM, SC	A-2-4, A-4	5-23	85-100	80-100	55-80	30-50	20-30	5-10
	5-18	Clay, sandy clay, clay loam.	CL, SC	A-6, A-7	0-5	85-100	80-100	80-100	48-80	30-45	15-25
	18-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
DeA---------- Deandale	0-9	Loam----------	CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	5-25
	9-80	Clay, clay loam, silty clay.	CL, CH	A-6, A-7-6	0	95-100	95-100	94-100	70-98	35-60	20-40
DeB---------- Deandale	0-8	Loam----------	CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	5-25
	8-80	Clay, clay loam, silty clay.	CL, CH	A-6, A-7-6	0	95-100	95-100	94-100	70-98	35-60	20-40
DnA---------- Deandale	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	5-25
	8-80	Clay, clay loam, silty clay.	CL, CH	A-6, A-7-6	0	95-100	95-100	94-100	70-98	35-60	20-40
DnB---------- Deandale	0-5	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	5-25
	5-80	Clay, clay loam, silty clay.	CL, CH	A-6, A-7-6	0	95-100	95-100	94-100	70-98	35-60	20-40
DsA---------- Deandale	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	5-25
	8-80	Clay, clay loam, silty clay.	CL, CH	A-6, A-7-6	0	95-100	95-100	94-100	70-98	35-60	20-40

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
Gm Gracemore	0-5	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-4	0	90-100	85-100	85-100	36-60	<26	NP-7
	5-80	Fine sand	SM, SP-SM	A-2, A-3	0	90-100	85-100	82-100	5-35	---	NP
GrC Grandfield	0-6	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	6-36	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	36-80	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
HoA Hollister	0-9	Silty clay loam	CL	A-6, A-7-6	0	100	95-100	90-100	75-95	35-50	17-30
	9-58	Clay, silty clay loam, clay loam.	CL, CH	A-7-6	0	98-100	96-100	90-100	75-96	41-60	20-35
	58-80	Clay, silty clay loam, clay loam.	CL, CH	A-7-6	0	98-100	96-100	85-99	75-96	41-55	20-32
HoB Hollister	0-6	Silty clay loam	CL	A-6, A-7-6	0	100	95-100	90-100	75-95	35-50	17-30
	6-58	Clay, silty clay loam, clay loam.	CL, CH	A-7-6	0	98-100	96-100	90-100	75-96	41-60	20-35
	58-80	Clay, silty clay loam, clay loam.	CL, CH	A-7-6	0	98-100	96-100	85-99	75-96	41-55	20-32
JoC*:											
Jolly	0-5	Fine sandy loam	SM, ML, SC-SM	A-2, A-4	0	95-100	90-100	80-100	35-60	<30	NP-7
	5-11	Sandy clay loam	SC, CL	A-4, A-6	0	98-100	95-100	80-100	30-55	25-40	8-20
	11-18	Fine sandy loam, sandy clay loam.	SC	A-6, A-2-6, A-4, A-2-4	0-3	90-100	90-100	80-100	20-50	25-40	8-20
	18-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop	0-80	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
KaA Kamay	0-10	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	60-90	20-40	5-20
	10-18	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	70-98	35-60	18-40
	18-81	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	70-98	35-60	18-40
KaB Kamay	0-7	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	60-90	20-40	5-20
	7-11	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	70-98	35-60	18-40
	11-90	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	70-98	35-60	18-40
KDA*:											
Kamay	0-11	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	60-90	20-40	5-20
	11-73	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	70-98	35-60	18-40
	73-90	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	70-98	35-60	18-40

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
KDA*:											
Deandale	0-12	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	5-25
	12-80	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	95-100	95-100	70-98	35-60	20-40
KvD*:											
Knoco	0-9	Clay	CL, CH	A-7-6, A-6	0-2	90-100	80-100	75-100	60-90	32-60	14-38
	9-60	Clay, shale	CL, CH	A-7-6, A-6	0-2	90-100	85-100	70-100	70-100	30-60	13-38
Vernon	0-4	Clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	4-19	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-40
	19-63	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
	63-80	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
KvE*:											
Knoco	0-9	Very bouldery clay.	CL, CH	A-6, A-7-6	10-30	80-100	80-100	80-100	80-98	32-60	14-38
	9-60	Clay, shale	CL, CH	A-6, A-7-6	0-2	90-100	85-100	75-100	70-100	30-60	13-38
Vernon	0-3	Very bouldery clay.	CL, CH	A-6, A-7-6	10-30	80-100	80-100	80-100	80-98	38-60	20-38
	3-19	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	95-100	80-100	80-98	32-60	20-40
	19-60	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	75-100	65-95	30-60	15-38
	60-80	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
Ma, Mc	0-5	Clay	CL, CH	A-7-6	0	100	100	98-100	90-100	40-70	20-45
Mangum	5-41	Clay, silty clay	CL, CH	A-7-6	0	100	100	95-100	90-100	41-70	20-45
	41-80	Clay loam, silty clay, silty clay loam.	CL	A-6, A-7-6	0	100	100	95-100	90-100	28-50	11-25
Mw*:											
Mangum	0-6	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	12-25
	6-18	Clay, silty clay	CL, CH	A-7-6	0	100	100	95-100	90-100	41-70	20-45
	18-38	Clay loam, silty clay, silty clay loam.	CL	A-6, A-7-6	0	100	100	95-100	90-100	28-50	11-25
	38-80	Silt loam, very fine sandy loam.	CL, ML-CL	A-4, A-6	0	100	98-100	95-100	65-98	20-40	5-22
Wheatwood	0-12	Silty clay loam	CL	A-4, A-6	0	100	98-100	95-100	75-98	20-40	9-22
	12-40	Silt loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
	40-80	Silty clay loam, very fine sandy loam.	CL, ML-CL	A-4, A-6	0	100	98-100	95-100	65-98	20-40	5-22

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
Ow*---------- Oil-waste land	0-80	Variable---------	---	---	---	---	---	---	---	---	---
Po*:											
Port----------	0-21	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	21-80	Silty clay loam, clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
Wheatwood-------	0-34	Silty clay loam	CL	A-4, A-6	0	100	98-100	95-100	75-98	20-40	9-22
	34-80	Silt loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
Pw*:											
Port----------	0-21	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	21-80	Silty clay loam, clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
Wheatwood-------	0-10	Silty clay loam	CL	A-4, A-6	0	100	98-100	95-100	75-98	20-40	9-22
	10-80	Silt loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
RoA---------- Rotan	0-8	Silty clay loam	CL	A-4, A-6	0	98-100	96-100	95-100	75-95	25-35	8-16
	8-47	Clay, clay loam, silty clay loam.	CL, CH	A-6, A-7-6	0	98-100	96-100	95-100	75-95	35-58	20-38
	47-80	Clay loam, clay	CL, CH	A-6, A-7-6	0	90-100	80-100	75-99	65-95	30-55	15-35
RoB---------- Rotan	0-7	Silty clay loam	CL	A-4, A-6	0	98-100	96-100	95-100	75-95	25-35	8-16
	7-30	Clay, clay loam, silty clay loam.	CL, CH	A-6, A-7-6	0	98-100	96-100	95-100	75-95	35-58	20-38
	30-80	Clay loam, clay	CL, CH	A-6, A-7-6	0	90-100	80-100	75-99	65-95	30-55	15-35
RwB---------- Rowden	0-7	Clay loam--------	CL	A-6, A-7-6	0-5	90-100	90-100	80-100	60-90	32-46	12-23
	7-30	Clay, clay loam	CH, CL	A-7-6	0-5	85-100	80-100	75-100	61-91	41-60	20-35
	30-35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
TcA---------- Tillman	0-8	Clay loam--------	CL	A-6	0	100	100	98-100	70-90	25-40	11-23
	8-76	Clay, clay loam	CL, CH	A-6, A-7-6	0	98-100	93-100	90-98	70-95	38-60	20-38
	76-80	Clay, clay loam	CL, CH	A-6, A-7-6	0-5	95-100	90-100	80-97	60-90	28-55	13-35
TcB---------- Tillman	0-6	Clay loam--------	CL	A-6	0	100	100	98-100	70-90	25-40	11-23
	6-73	Clay, clay loam	CL, CH	A-6, A-7-6	0	98-100	93-100	90-98	70-95	38-60	20-38
	73-80	Clay, clay loam	CL, CH	A-6, A-7-6	0-5	95-100	90-100	80-97	60-90	28-55	13-35
VeC---------- Vernon	0-5	Clay----------	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	5-35	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-40
	35-80	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
VkD*:											
Vernon	0-4	Clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	4-27	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-40
	27-60	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
Knoco	0-9	Clay	CL, CH	A-7-6, A-6	0-2	90-100	80-100	75-100	60-90	32-60	14-38
	9-20	Clay, shale	CL, CH	A-7-6, A-6	0-2	90-100	85-100	70-100	70-100	30-60	13-38
	20-60	Clay, shale	CL, CH	A-7-6, A-6	0-2	90-100	85-100	70-100	70-100	30-60	13-38
VlD*:											
Vernon	0-5	Clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	5-18	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-40
	18-60	Clay, shale	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-96	30-60	15-38
Latom	0-6	Stony fine sandy loam.	SM, SC-SM	A-2, A-4	5-10	90-100	75-95	55-75	30-50	<25	NP-7
	6-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Wc	0-16	Silty clay	CL, CH	A-7-6	0	100	100	98-100	95-100	41-55	24-35
Westfork	16-38	Silty clay loam, silty clay, clay.	CL, CH	A-7-6	0	100	100	98-100	95-100	41-55	24-35
	38-80	Silty clay loam, silty clay, clay.	CL, CH	A-7-6	0	100	100	95-100	90-100	41-55	24-35
WdC	0-5	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-4	0	98-100	95-100	70-90	35-65	<25	NP-7
Weswind	5-22	Clay loam, sandy clay, clay.	CL, CH	A-7-6, A-6	0	95-100	90-100	80-100	65-95	35-54	20-36
	22-48	Clay loam, sandy clay, clay.	CL, CH	A-6, A-7-6	0	95-100	85-100	80-100	60-85	30-52	14-32
	48-80	Clay	CH, CL	A-7-6	0	95-100	95-100	80-100	70-99	41-54	23-36
We	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	100	98-100	90-100	65-95	20-35	5-18
Wheatwood	6-80	Silt loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
WhA	0-8	Clay loam	CL	A-6	0	98-100	96-100	90-100	70-90	28-40	11-20
Wichita	8-17	Clay loam, clay, silty clay.	CL	A-6, A-7-6	0	98-100	96-100	90-100	70-98	36-50	20-30
	17-70	Clay loam, clay, silty clay.	CL	A-6, A-7-6	0	96-100	90-100	80-100	65-95	30-50	15-30

See footnote at end of table.

TABLE 14 --ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
WhB---------- Wichita	0-7	Clay loam--------	CL	A-6	0	98-100	96-100	90-100	70-90	28-40	11-20
	7-60	Clay loam, clay, silty clay.	CL	A-6, A-7-6	0	98-100	96-100	90-100	70-98	36-50	20-30
	60-80	Clay loam, clay, silty clay.	CL	A-6, A-7-6	0	96-100	90-100	80-100	65-95	30-50	15-30
WlC---------- Windthorst	0-6	Fine sandy loam	SM, SC-SM, CL-ML, ML	A-4	0	100	95-100	75-100	36-65	<28	NP-7
	6-30	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7-6	0	95-100	95-100	85-100	60-89	35-53	20-35
	30-37	Sandy clay loam, sandy clay, clay loam.	CL	A-4, A-6, A-7-6	0	95-100	90-100	75-100	55-84	25-45	8-28
	37-80	Sandy clay loam, fine sandy loam, shale.	SC, CL	A-4, A-6, A-7-6	0	90-100	90-100	75-100	45-74	25-45	8-28
WnA---------- Winters	0-11	Loam----------	CL, CL-ML	A-4, A-6	0	98-100	95-100	75-100	51-85	24-35	6-15
	11-68	Sandy clay, clay, clay loam.	CL, CH	A-7-6	0	95-100	90-100	80-100	60-90	41-52	20-30
	68-80	Clay loam, sandy clay loam, sandy clay.	CL, CH	A-6, A-7-6	0	95-100	90-100	80-100	51-87	27-52	14-33
WnB---------- Winters	0-7	Loam----------	CL, CL-ML	A-4, A-6	0	98-100	95-100	75-100	51-85	24-35	6-15
	7-50	Sandy clay, clay, clay loam.	CL, CH	A-7-6	0	95-100	90-100	80-100	60-90	41-52	20-30
	50-80	Clay loam, sandy clay loam, sandy clay.	CL, CH	A-6, A-7-6	0	95-100	90-100	80-100	51-87	27-52	14-33
Yo---------- Yomont	0-9	Very fine sandy loam.	ML, CL-ML	A-4	0	100	98-100	85-98	51-75	<30	NP-7
	9-84	Very fine sandy loam, loam, silt loam.	ML, CL-ML	A-4	0	100	98-100	85-100	55-85	<30	NP-7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
AsC3----------	0-7	27-35	1.40-1.55	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.37	4	4L	.5-2
Aspermont	7-40	27-35	1.40-1.60	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.37			
	40-80	27-35	1.45-1.65	0.6-2.0	0.10-0.18	7.9-8.4	<2	Moderate	0.37			
Ba*----------	0-40	---	---	---	---	---	---	----------	0.43	1	8	<.5
Badland												
BeB----------	0-8	10-20	1.35-1.45	2.0-6.0	0.10-0.15	5.6-7.3	<2	Low-------	0.32	2	3	.5-1
Bluegrove	8-29	35-45	1.40-1.60	0.2-0.6	0.15-0.20	5.6-7.8	<2	Moderate	0.32			
	29-45	---	---	---	---	---	---	----------	----			
BtC----------	0-7	10-20	1.35-1.55	0.6-2.0	0.11-0.15	5.6-7.3	<2	Low-------	0.37	2	3	.5-2
Bonti	7-35	30-50	1.35-1.60	0.2-0.6	0.15-0.20	5.1-7.3	<2	Moderate	0.32			
	35-60	---	---	---	---	---	---	----------	----			
DaD*:												
Darnell----------	0-4	10-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low-------	0.10	1	8	.5-1
	4-11	10-25	1.40-1.70	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low-------	0.32			
	11-40	---	---	---	---	---	---	----------	----			
Exray----------	0-5	7-22	1.40-1.60	0.6-2.0	0.08-0.14	6.1-7.3	<2	Low-------	0.20	1	8	.5-1
	5-18	35-50	1.40-1.60	0.2-0.6	0.12-0.20	5.6-6.5	<2	Moderate	0.32			
	18-40	---	---	---	---	---	---	----------	----			
DeA----------	0-9	15-27	1.30-1.50	0.6-2.0	0.15-0.20	6.1-8.4	<4	Low-------	0.43	5	6	1-3
Deandale	9-80	35-45	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	<4	High------	0.32			
DeB, DnA----------	0-8	15-27	1.30-1.50	0.6-2.0	0.15-0.20	6.1-8.4	<4	Low-------	0.43	5	6	1-3
Deandale	8-80	35-45	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	<4	High------	0.32			
DnB----------	0-5	15-27	1.30-1.50	0.6-2.0	0.15-0.20	6.1-8.4	<4	Low-------	0.43	5	6	1-3
Deandale	5-80	35-45	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	<4	High------	0.32			
DsA----------	0-8	15-27	1.30-1.50	0.6-2.0	0.15-0.20	6.1-8.4	<4	Low-------	0.43	5	6	1-3
Deandale	8-80	35-45	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	<4	High------	0.32			
Gm----------	0-5	5-30	1.30-1.60	2.0-6.0	0.08-0.15	7.4-8.4	<4	Low-------	0.20	5	3	.5-1
Gracemore	5-80	2-10	1.50-1.70	2.0-20	0.05-0.11	7.9-8.4	<4	Low-------	0.17			
GrC----------	0-6	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.3	<2	Low-------	0.24	5	3	.5-1
Grandfield	6-36	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.1-7.3	<2	Low-------	0.32			
	36-80	12-25	1.50-1.70	2.0-6.0	0.11-0.15	6.1-8.4	<2	Low-------	0.28			
HoA----------	0-9	27-40	1.30-1.60	0.2-0.6	0.15-0.20	6.6-8.4	<2	High------	0.32	5	6	1-3
Hollister	9-58	35-50	1.35-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High------	0.32			
	58-80	35-50	1.35-1.65	0.06-0.2	0.11-0.17	7.9-8.4	<2	High------	0.32			
HoB----------	0-6	27-40	1.30-1.60	0.2-0.6	0.15-0.20	6.6-8.4	<2	High------	0.32	5	6	1-3
Hollister	6-58	35-50	1.35-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High------	0.32			
	58-80	35-50	1.35-1.65	0.06-0.2	0.11-0.17	7.9-8.4	<2	High------	0.32			
JoC*:												
Jolly----------	0-5	10-18	1.35-1.45	0.6-2.0	0.11-0.16	5.6-7.3	<2	Low-------	0.20	1	8	.5-1
	5-11	20-30	1.40-1.60	0.6-2.0	0.12-0.16	6.1-7.3	<2	Low-------	0.32			
	11-18	15-30	1.45-1.65	0.6-2.0	0.12-0.16	6.1-7.3	<2	Low-------	0.32			
	18-40	---	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
JoC*:												
Rock outcrop	0-80	---	---	---	---	---	---					
KaA	0-10	15-25	1.40-1.60	0.6-2.0	0.15-0.20	6.1-7.8	<2	Low	0.37	5	5	.5-2
Kamay	10-18	40-45	1.40-1.70	0.06-0.2	0.12-0.18	7.4-8.4	<4	High	0.32			
	18-81	27-45	1.40-1.70	0.06-0.2	0.12-0.18	7.9-8.4	4-16	High	0.32			
KaB	0-7	15-25	1.40-1.60	0.6-2.0	0.15-0.20	6.1-7.8	<2	Low	0.37	5	5	.5-2
Kamay	7-11	35-45	1.40-1.70	0.06-0.2	0.12-0.18	6.6-8.4	<4	High	0.32			
	11-90	35-45	1.40-1.70	0.06-0.2	0.12-0.18	7.9-8.4	4-16	High	0.32			
KDA*:												
Kamay	0-11	15-25	1.40-1.60	0.6-2.0	0.01-0.15	6.1-7.8	4-16	Low	0.37	5	5	.5-2
	11-73	35-45	1.40-1.70	0.06-0.2	0.01-0.14	6.6-8.4	>4	High	0.32			
	73-90	40-60	1.40-1.70	0.06-0.2	0.01-0.10	7.9-8.4	>4	High	0.32			
Deandale	0-12	15-27	1.35-1.50	0.6-2.0	0.05-0.16	6.6-8.4	4-16	Low	0.43	5	6	1-3
	12-80	35-55	1.40-1.55	<0.06	0.01-0.14	7.4-8.4	>4	High	0.37			
KvD*:												
Knoco	0-9	40-60	1.35-1.55	<0.06	0.07-0.13	7.9-8.4	<2	High	0.37	1	4	.5-2
	9-60	40-60	1.70-2.25	<0.06	0.07-0.10	7.9-8.4	<2	High	0.32			
Vernon	0-4	40-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.32	3	4	.5-2
	4-19	40-60	1.50-1.65	<0.06	0.10-0.15	7.9-8.4	<2	High	0.37			
	19-63	40-60	1.60-1.75	<0.06	0.06-0.10	7.9-8.4	<8	High	0.37			
	63-80	40-60	1.70-2.00	<0.06	0.01-0.06	7.9-8.4	<8	High	0.32			
KvE*:												
Knoco	0-9	40-60	1.40-1.60	<0.06	0.10-0.17	7.9-8.4	<2	High	0.28	1	8	.5-2
	9-60	40-60	1.70-2.25	<0.06	0.03-0.08	7.9-8.4	<2	High	0.32			
Vernon	0-3	40-60	1.40-1.60	<0.06	0.10-0.17	7.9-8.4	<2	High	0.28	3	8	.5-2
	3-19	40-60	1.45-1.65	<0.06	0.10-0.17	7.9-8.4	<2	High	0.37			
	19-60	40-60	1.60-1.75	<0.06	0.01-0.08	7.9-8.4	<8	High	0.37			
	60-80	40-60	1.70-2.00	<0.06	0.01-0.06	7.9-8.4	<8	High	0.32			
Ma, Mc	0-5	40-60	1.30-1.55	<0.06	0.14-0.18	7.9-8.4	<2	High	0.32	5	4	.5-3
Mangum	5-41	40-60	1.30-1.65	<0.06	0.14-0.18	7.9-8.4	<4	High	0.32			
	41-80	30-55	1.40-1.65	<0.06	0.15-0.20	7.9-8.4	<8	Moderate	0.32			
Mw*:												
Mangum	0-6	28-40	1.30-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32	5	4L	.5-3
	6-18	40-60	1.30-1.65	<0.06	0.14-0.18	7.9-8.4	<4	High	0.32			
	18-38	30-55	1.40-1.65	<0.06	0.15-0.20	7.9-8.4	<8	Moderate	0.32			
	38-80	15-27	1.45-1.65	0.6-2.0	0.15-0.22	7.9-8.4	<8	Low	0.43			
Wheatwood	0-12	27-35	1.30-1.50	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43	5	6	1-4
	12-40	20-35	1.35-1.55	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43			
	40-80	15-35	1.35-1.65	0.6-2.0	0.15-0.22	7.9-8.4	<8	Low	0.43			
Ow* Oil-waste land	0-80	---	---	---	---	---	>16					
Po*:												
Port	0-21	27-35	1.30-1.60	0.6-2.0	0.15-0.24	5.6-7.8	<2	Moderate	0.32	5	---	1-3
	21-80	20-35	1.30-1.60	0.6-2.0	0.15-0.24	6.6-8.4	<2	Moderate	0.37			
Wheatwood	0-34	20-35	1.30-1.50	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43	5	4L	1-4
	34-80	20-35	1.35-1.55	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Pw*:												
Port	0-21	27-35	1.30-1.60	0.6-2.0	0.15-0.24	5.6-7.8	<2	Moderate	0.32	5	7	1-3
	21-80	20-35	1.30-1.60	0.6-2.0	0.15-0.24	6.6-8.4	<2	Moderate	0.37			
Wheatwood	0-10	20-35	1.30-1.50	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43	5	4L	1-4
	10-80	20-35	1.35-1.55	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43			
RoA	0-8	28-35	1.30-1.45	0.6-2.0	0.15-0.20	6.1-8.4	<2	Moderate	0.32	5	6	1-3
Rotan	8-47	35-45	1.45-1.60	0.2-0.6	0.14-0.18	7.4-8.4	<2	High	0.32			
	47-80	28-45	1.45-1.68	0.6-2.0	0.12-0.16	7.9-8.4	<4	Moderate	0.32			
RoB	0-7	28-35	1.30-1.45	0.6-2.0	0.15-0.20	6.1-8.4	<2	Moderate	0.32	5	6	1-3
Rotan	7-30	35-45	1.45-1.60	0.2-0.6	0.14-0.18	7.4-8.4	<2	High	0.32			
	30-80	28-45	1.45-1.68	0.6-2.0	0.12-0.16	7.9-8.4	<4	Moderate	0.32			
RwB	0-7	27-35	1.30-1.45	0.6-2.0	0.14-0.20	7.4-8.4	<2	Moderate	0.32	2	6	1-3
Rowden	7-30	35-55	1.35-1.50	0.06-0.2	0.12-0.20	6.6-8.4	<2	High	0.32			
	30-35	---	---	---	---	---	---	---	---			
TcA	0-8	27-35	1.30-1.45	0.2-0.6	0.15-0.20	7.4-8.4	<2	Moderate	0.32	5	6	1-3
Tillman	8-76	35-45	1.45-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High	0.32			
	76-80	35-45	1.45-1.70	0.06-0.2	0.11-0.17	7.9-8.4	<4	High	0.32			
TcB	0-6	27-35	1.30-1.45	0.2-0.6	0.15-0.20	7.4-8.4	<2	Moderate	0.32	5	6	1-3
Tillman	6-73	35-45	1.45-1.65	0.06-0.2	0.12-0.18	7.4-8.4	<2	High	0.32			
	73-80	35-45	1.45-1.70	0.06-0.2	0.11-0.17	7.9-8.4	<4	High	0.32			
VeC	0-5	40-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.32	3	4	.5-2
Vernon	5-35	40-60	1.50-1.65	<0.06	0.10-0.15	7.9-8.4	<2	High	0.37			
	35-80	40-60	1.60-1.75	<0.06	0.06-0.10	7.9-8.4	<8	High	0.37			
VkD*:												
Vernon	0-4	40-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.32	3	4	.5-2
	4-27	40-60	1.50-1.65	<0.06	0.10-0.15	7.9-8.4	<2	High	0.37			
	27-60	40-60	1.60-1.75	<0.06	0.06-0.10	7.9-8.4	<8	High	0.37			
Knoco	0-9	40-55	1.35-1.55	<0.06	0.07-0.13	7.9-8.4	<2	High	0.37	1	4	.5-2
	9-20	40-55	1.45-1.70	<0.06	0.07-0.10	7.9-8.4	<2	High	0.32			
	20-60	40-55	1.70-2.25	<0.06	0.-0.08	7.9-8.4	<2	High	0.32			
VlD*:												
Vernon	0-5	35-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.32	3	8	.5-2
	5-18	40-60	1.50-1.65	<0.06	0.10-0.15	7.9-8.4	<2	High	0.37			
	18-60	40-60	1.60-1.75	<0.06	0.06-0.10	7.9-8.4	<8	High	0.37			
Latom	0-6	5-18	1.40-1.60	0.6-2.0	0.10-0.13	7.9-8.4	<2	Low	0.15	1	8	.5-1
	6-20	---	---	---	---	---	---	---	---			
Wc	0-16	40-60	1.20-1.30	<0.06	0.12-0.18	6.1-7.8	<2	High	0.28	5	4	1-4
Westfork	16-38	35-60	1.25-1.35	<0.06	0.12-0.18	6.1-8.4	<2	High	0.32			
	38-80	35-60	1.30-1.40	<0.06	0.12-0.18	6.6-8.4	<2	High	0.32			
WdC	0-5	7-15	1.30-1.45	2.0-6.0	0.10-0.15	5.6-6.5	<2	Low	0.32	5	3	.5-1
Weswind	5-22	35-45	1.40-1.60	0.2-0.6	0.13-0.18	5.6-7.8	<2	Moderate	0.32			
	22-48	27-45	1.50-1.65	0.2-0.6	0.12-0.18	6.6-8.4	<2	Moderate	0.32			
	48-80	35-45	1.50-1.70	0.06-0.2	0.10-0.14	7.9-8.4	<2	Moderate	0.32			
We	0-6	15-27	1.30-1.50	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low	0.43	5	6	1-4
Wheatwood	6-80	20-35	1.35-1.55	0.6-2.0	0.15-0.22	7.9-8.4	<2	Low	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
WhA	0-8	28-35	1.30-1.45	0.6-2.0	0.15-0.20	6.6-7.8	<2	Moderate	0.32	5	6	.5-1
Wichita	8-17	35-45	1.30-1.45	0.2-0.6	0.15-0.20	6.6-8.4	<2	Moderate	0.32			
	17-70	35-45	1.55-1.75	<0.06	0.02-0.10	7.9-8.4	<8	High	0.37			
WhB	0-7	28-35	1.30-1.45	0.6-2.0	0.15-0.20	6.6-7.8	<2	Moderate	0.32	5	6	.5-1
Wichita	7-60	35-45	1.30-1.45	0.2-0.6	0.15-0.20	6.6-8.4	<2	Moderate	0.32			
	60-80	35-45	1.55-1.75	<.06	0.02-0.10	7.9-8.4	<8	High	0.37			
WlC	0-6	5-18	1.45-1.60	0.6-2.0	0.12-0.16	5.6-7.3	<2	Low	0.49	5	3	.5-1
Windthorst	6-30	35-45	1.45-1.65	0.2-0.6	0.12-0.17	6.1-8.4	<2	Moderate	0.37			
	30-37	30-45	1.50-1.68	0.2-0.6	0.12-0.16	6.1-8.4	<2	Moderate	0.37			
	37-80	35-45	1.50-1.70	0.2-0.6	0.11-0.16	5.6-8.4	<2	Moderate	0.49			
WnA	0-11	15-25	1.35-1.50	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low	0.28	5	5	.5-1
Winters	11-68	35-45	1.45-1.60	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.28			
	68-80	25-40	1.50-1.65	0.6-2.0	0.14-0.18	7.9-8.4	<2	Moderate	0.24			
WnB	0-7	15-25	1.35-1.50	0.6-2.0	0.15-0.19	6.1-7.8	<2	Low	0.28	5	5	.5-1
Winters	7-50	35-45	1.45-1.60	0.2-0.6	0.14-0.18	6.1-7.8	<2	Moderate	0.28			
	50-80	25-45	1.50-1.65	0.6-2.0	0.14-0.18	7.9-8.4	<2	Moderate	0.24			
Yo	0-9	10-18	1.30-1.55	2.0-6.0	0.14-0.18	7.9-8.4	<2	Low	0.49	5	3	.5-1
Yomont	9-84	10-18	1.40-1.60	2.0-6.0	0.14-0.20	7.9-8.4	<2	Low	0.49			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Uncoated steel	Concrete
					In			
AsC3---------- Aspermont	B	None--------	---	---	>60	---	Moderate	Low.
Ba*---------- Badland	D	None--------	---	---	>60	---	High-----	Low.
BeB---------- Bluegrove	C	None--------	---	---	20-40	Soft	Moderate	Low.
BtC---------- Bonti	C	None--------	---	---	20-40	Hard	High-----	Moderate.
DaD*:								
Darnell----------	C	None--------	---	---	10-15	Soft	Low------	Moderate.
Exray----------	D	None--------	---	---	12-18	Hard	High-----	Moderate.
DeA, DeB, DnA, DnB, DsA--------- Deandale	D	None--------	---	---	>60	---	High-----	Moderate.
Gm**---------- Gracemore	C	Frequent----	Very brief	Mar-Nov	>60	---	Moderate	Low.
GrC---------- Grandfield	B	None--------	---	---	>60	---	Low------	Low.
HoA, HoB---------- Hollister	D	None--------	---	---	>60	---	High-----	Low.
JoC*:								
Jolly----------	C	None--------	---	---	12-20	Soft	Low------	Low.
Rock outcrop-----	D	None--------	---	---	0-2	Hard	High-----	Low.
KaA, KaB---------- Kamay	D	None--------	---	---	>60	---	High-----	Moderate.
KDA*:								
Kamay----------	D	None--------	---	---	>60	---	High-----	Moderate.
Deandale---------	D	None--------	---	---	>60	---	High-----	Moderate.
KvD*:								
Knoco----------	D	None--------	---	---	3-14	Soft	High-----	Low.
Vernon----------	D	None--------	---	---	>60	---	High-----	Low.
KvE*:								
Knoco----------	D	None--------	---	---	9-19	Soft	High-----	Low.
Vernon----------	D	None--------	---	---	>60	---	High-----	Low.
Ma---------- Mangum	D	Occasional	Very brief	Apr-Oct	>60	---	High-----	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Uncoated steel	Concrete
					In			
Mc Mangum	D	Frequent	Very brief	Apr-Oct	>60	---	High	Low.
Mw*:								
Mangum	D	Occasional	Very brief	Apr-Oct	>60	---	High	Low.
Wheatwood	B	Occasional	Brief	Apr-Oct	>60	---	High	Low.
Ow* Oil-waste land	D	Rare	---	---	>60	---	High	Moderate.
Po*:								
Port	B	Occasional	Very brief to brief.	Mar-Oct	>60	---	Moderate	Low.
Wheatwood	B	Occasional	Brief	Mar-Oct	>60	---	High	Low.
Pw*:								
Port	B	Frequent	Very brief to brief.	Mar-Oct	>60	---	Moderate	Low.
Wheatwood	B	Frequent	Brief	Mar-Oct	>60	---	High	Low.
RoA, RoB Rotan	C	None	---	---	>60	---	High	Low.
RwB Rowden	C	None	---	---	20-40	Hard	High	Low.
TcA, TcB Tillman	C	None	---	---	>60	---	High	Low.
VeC Vernon	D	None	---	---	>60	---	High	Low.
VkD*:								
Vernon	D	None	---	---	>60	---	High	Low.
Knoco	D	None	---	---	4-19	Soft	High	Low.
VlD*:								
Vernon	D	None	---	---	>60	---	High	Low.
Latom	D	None	---	---	6-10	Hard	Low	Low.
Wc Westfork	D	Occasional	Brief	Apr-Nov	>60	---	High	Low.
WdC Weswind	C	None	---	---	>60	---	High	Low.
We Wheatwood	B	Occasional	Brief	Mar-Oct	>60	---	High	Low.
WhA, WhB Wichita	C	None	---	---	>60	---	Moderate	Low.
WlC Windthorst	C	None	---	---	>60	---	High	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Uncoated steel	Concrete
					In			
WnA, WnB---------- Winters	C	None--------	---	---	>60	---	High-----	Low.
Yo---------- Yomont	B	Occasional	Very brief	Apr-Nov	>60	---	Low------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.
** Gracemore soils have an apparent water table at a depth of 0.5 foot to 6.0 feet.

TABLE 17.--PHYSICAL ANALYSIS OF SELECTED SOILS

(A dash indicates material was not detected or data were not determined. The symbol TR means trace)

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Sand: Coarse (1-0.5 mm)	Sand: Medium (0.5-0.25 mm)	Sand: Fine (0.25-0.1 mm)	Sand: Very fine (0.1-0.05 mm)	Sand: Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	COLE	Bulk density	Water content: 1/3 bar	Water content: 15 bar	Available water capacity
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Cm/cm	g/cm^3	--Pct (wt)---		Cm/cm
Bluegrove*	0-4	A	0.1	0.2	2.7	48.3	23.1	74.4	19.1	6.5	0.002	1.42	9.7	3.0	0.10
(S81TX-009-010)	4-10	Bt1	0.1	0.2	1.9	34.3	18.7	55.2	19.1	25.7	0.025	1.58	16.3	9.2	0.11
	10-17	Bt2	0.6	0.3	1.3	23.3	15.4	40.9	17.7	41.4	0.046	1.45	21.8	14.5	0.11
	17-24	Bt3	0.4	0.4	0.9	16.2	19.3	37.2	18.5	44.3	0.051	1.50	23.3	15.3	0.12
	24-34	BC	0.2	0.2	0.5	10.3	31.1	42.3	21.8	35.9	0.042	1.59	19.4	12.3	0.11
	34-40	Cr	1.6	1.3	1.4	31.3	29.3	64.9	16.4	18.7	---	1.70	---	6.9	---
	40-60	R	1.9	2.1	3.5	64.5	12.7	84.7	8.9	6.4	---	1.70	---	2.0	---
Bonti* **	0-4	A1	0.5	1.2	16.1	33.9	11.3	63.0	26.7	10.3	0.015	1.53	8.7	4.5	0.05
(S81TX-009-011)	4-8	A2	0.2	1.5	16.3	34.2	8.9	61.1	23.4	15.5	0.015	1.54	10.9	6.0	0.08
	8-14	Bt1	1.1	1.9	15.2	28.4	6.7	53.3	20.2	26.5	0.025	1.57	14.8	9.9	0.08
	14-18	Bt2	0.9	2.5	16.5	28.2	5.5	53.6	15.6	30.8	0.026	1.59	17.2	11.7	0.09
	18-27	Bt3	0.4	2.1	18.8	30.7	5.4	57.4	13.7	28.9	0.021	1.66	15.8	10.8	0.08
	27-45	R	1.0	3.1	34.6	42.1	3.2	83.9	6.0	10.1	0.003	1.93	5.2	3.8	0.03
Deandale*	0-6	A1	0.1	0.2	0.3	3.3	15.9	19.8	58.5	21.7	0.031	1.45	18.3	9.5	0.13
(S81TX-009-007)	6-10	A2	0.1	0.2	0.3	3.0	14.6	18.2	58.0	23.8	0.038	1.43	19.9	10.7	0.13
	10-17	Bt1	0.2	0.1	0.2	2.3	10.3	13.1	42.6	44.3	0.083	1.41	28.6	21.8	0.10
	17-24	Bt2	0.7	0.4	0.3	2.4	11.5	15.3	44.8	39.9	0.084	1.49	25.0	19.0	0.09
	24-37	Btk1	1.0	1.0	0.4	2.4	10.7	15.5	46.5	38.0	0.088	1.49	24.4	12.1	0.18
	37-45	Bty	1.2	0.9	0.5	2.3	10.3	15.2	46.3	38.5	0.088	1.47	25.9	16.5	0.13
	45-52	Bt3	1.1	0.9	0.5	2.4	10.4	15.3	46.0	38.7	0.087	1.54	24.2	16.3	0.12
	52-69	Bt4	1.2	1.1	0.8	3.3	11.9	18.3	45.8	35.9	0.054	1.61	20.6	14.7	0.09
	69-86	Btk2	1.1	1.2	0.9	3.4	16.1	22.7	47.0	30.3	0.040	1.72	17.4	12.1	0.09
	86-104	Btk3	0.2	0.2	0.4	6.0	19.5	26.3	40.9	32.8	---	1.70	---	13.4	---
	104-110	Btkcb1	3.0	0.9	0.5	4.7	14.9	24.0	41.9	34.1	---	1.70	---	13.5	---
	110-120	Btb	0.6	0.9	0.6	2.4	10.0	14.5	55.1	30.4	---	1.70	---	11.8	---
	120-126	Cr	2.4	1.6	0.7	1.0	6.4	12.1	63.7	24.2	---	1.70	---	9.2	---
Kamay* ***	0-4	A1	0.1	0.1	0.3	9.9	22.4	32.8	52.3	14.9	0.008	1.60	12.0	5.0	0.11
(S81TX-009-006)	4-8	A2	---	0.1	0.3	8.3	18.6	27.3	51.5	21.2	0.020	1.48	13.7	8.3	0.08
	8-18	Bt1	TR	0.1	0.2	6.0	12.9	19.2	40.2	40.6	0.104	1.44	28.0	17.4	0.15
	18-23	Btkc1	0.7	0.4	0.4	6.7	14.0	22.2	41.5	36.3	0.053	1.53	22.8	14.2	0.13
	23-38	Btkc2	0.7	0.7	0.4	7.8	15.8	25.4	42.3	32.3	0.046	1.50	20.6	13.3	0.11
	38-56	Btkc3	1.6	1.0	0.8	11.8	17.3	32.5	38.4	29.1	0.035	1.64	17.5	10.5	0.11
	56-62	Btkc4	1.0	1.1	0.8	11.9	17.4	32.2	38.0	29.8	0.029	1.71	16.3	10.9	0.09
	62-68	Btkc5	1.8	1.3	0.8	8.3	11.5	23.7	41.0	35.3	0.035	1.61	18.2	12.4	0.08
	68-73	2C	0.5	0.5	0.6	7.2	18.0	26.8	48.1	25.1	0.021	1.68	16.3	8.4	0.13
	82-88	4C	8.8	5.6	2.3	8.1	12.3	37.1	36.5	26.4	---	1.70	---	10.5	---

See footnotes at end of table.

TABLE 17.--PHYSICAL ANALYSIS OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Sand: Coarse (1-0.5 mm)	Sand: Medium (0.5-0.25 mm)	Sand: Fine (0.25-0.1 mm)	Sand: Very fine (0.1-0.05 mm)	Sand: Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	COLE	Bulk density	Water content: 1/3 bar	Water content: 15 bar	Available water capacity
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Cm/cm	g/cm^3	--Pct (wt)---		Cm/cm
Mangum*	0-3	A	---	0.1	0.1	0.3	0.5	1.0	37.4	61.6	0.079	1.48	25.4	19.9	0.08
(S81TX-009-009)	3-14	Akc	---	TR	0.1	0.2	0.3	0.6	39.5	59.9	0.078	1.51	23.4	17.6	0.09
	14-21	Bkc1	0.1	0.3	0.1	0.1	0.2	0.8	45.6	53.6	0.070	1.59	22.6	16.3	0.10
	21-38	Bkc2	0.1	0.2	0.1	0.1	0.1	0.6	45.7	53.7	0.064	1.65	21.4	16.6	0.08
	38-54	Bkc3	0.1	0.1	TR	0.1	0.1	0.4	44.1	55.5	0.070	1.60	22.1	17.2	0.08
	54-76	Ck	---	TR	TR	0.1	0.7	0.8	45.1	54.1	0.085	1.48	27.0	17.8	0.14
Rotan* ****	0-5	A1	TR	0.1	0.3	5.2	17.9	23.5	56.7	19.8	0.022	1.46	18.7	9.5	0.13
(S81TX-009-008)	5-12	A2	0.1	0.1	0.2	4.0	14.0	18.4	52.6	29.0	0.036	1.41	21.5	12.7	0.12
	12-18	Bt1	0.1	0.1	0.1	3.7	11.8	15.8	47.6	36.6	0.060	1.51	23.1	15.9	0.11
	18-26	Bt2	---	0.1	0.2	3.7	11.7	15.7	48.5	35.8	0.061	1.54	22.8	16.0	0.10
	26-34	Btk1	0.5	0.4	0.3	3.5	11.5	16.2	47.6	36.2	---	1.60	---	17.0	---
	34-43	Btk2	0.9	0.6	0.4	3.6	11.2	16.7	47.1	36.2	---	1.60	---	16.8	---
	43-51	Btkc1	0.5	0.5	0.3	3.2	10.7	15.2	49.4	35.4	---	1.60	---	15.5	---
	51-72	Btkc2	0.4	0.3	0.3	2.9	11.1	15.0	48.9	36.1	---	1.60	---	14.6	---
	72-93	Btkc3	0.6	0.8	0.8	2.9	10.4	15.5	51.6	32.9	---	1.66	---	13.2	0.08

* Locations of the sampled pedons are as follows:
Bluegrove: From State Highway 25 in Windthorst, 2.7 miles south on U.S. Highway 281, about 6.3 miles west on Farm Road 2581, about 0.45 mile south on an oil field road, 410 feet southeast of oil well, in an area of rangeland.
Bonti: From State Highway 25 in Archer City, 9.3 miles south on State Highway 79, about 4.1 miles east on a county road, 3.4 miles south, 0.65 mile southwest, 1,000 feet northwest on a ranch road, 40 feet east of an area of rangeland.
Deandale: From U.S. Highway 82 in Mankins, 0.97 mile south on State Highway 25, about 400 feet southwest on a ranch road, 70 feet northwest in an area of rangeland.
Kamay: From U.S. Highway 82 in Dundee, 3.25 miles north on Farm Road 2846, about 0.9 mile west on an oil field road, 700 feet south on a ranch road, across the dam of a pond, 700 feet south in an area of rangeland.
Mangum: From State Highway 25 in Archer City, 5.2 miles north on State Highway 79, about 2,200 feet east of a bridge, in an area of rangeland.
Rotan: From State Highway 25 in Mankins, 2.9 miles southwest on U.S. Highway 82, about 4.6 miles south on Farm Road 368, about 0.88 mile east on a county road, 0.22 mile south, 200 feet east of a road, in an area of rangeland.

** This Bonti pedon is a taxadjunct to the Bonti series because the clay content is less than 35 percent in the control section.

*** This Kamay pedon is a taxadjunct to the Kamay series because the clay mineralogy is mixed.

**** This Rotan pedon is a taxadjunct to the Rotan series because the clay mineralogy is montmorillonitic.

TABLE 18.--CHEMICAL ANAYLSIS OF SELECTED SOILS

(Dashes indicate that data were not determined. TR means trace; CEC, cation-exchange capacity; ESP, exchangeable sodium percentage; and SAR, sodium adsorption ratio)

Soil name and sample number	Depth	Horizon	Extractable bases					Extractable acidity	CEC (sum of cations)	Base saturation (sum)	Organic carbon	pH 1:2 CaCl2	$CaCO_3$	ESP	SAR	Electrical conductivity
			Ca	Mg	Na	K	Sum									
	In		Milliequivalents/100 grams of soil							Pct	Pct		Pct	Pct		Mmhos/cm
Bluegrove*	0-4	A	3.5	0.8	---	0.4	4.7	2.1	4.1	69	0.71	6.0	---	---	---	0.24
(S81TX-009-010)	4-10	Bt1	8.0	2.3	---	0.5	10.8	4.5	11.8	71	0.85	5.9	---	---	---	0.06
	10-17	Bt2	12.8	3.9	---	0.5	17.2	6.3	19.0	73	0.98	5.9	---	---	---	0.04
	17-24	Bt3	13.2	4.2	TR	0.4	17.8	5.9	21.1	75	0.71	6.3	---	---	---	0.05
	24-34	BC	13.3	4.0	0.2	0.4	17.9	3.2	18.4	85	0.41	6.5	TR	---	---	0.05
	34-40	Cr	---	2.2	0.1	0.2	---	---	8.6	---	0.28	7.8	5	---	---	0.16
	40-60	R	---	---	---	---	---	---	---	---	---	---	1	---	---	---
Bonti* **	0-4	A1	4.8	1.1	0.4	0.4	6.7	2.8	6.3	71	0.98	5.9	---	---	---	0.15
(S81TX-009-011)	4-8	A2	5.4	1.7	0.1	0.4	7.6	3.0	7.4	72	0.74	6.2	---	---	---	0.06
	8-14	Bt1	7.7	3.3	---	0.5	11.5	3.5	12.2	77	0.72	6.0	---	---	---	0.07
	14-18	Bt2	8.9	4.5	---	0.4	13.8	5.5	15.0	72	0.59	6.0	---	---	---	0.04
	18-27	Bt3	7.8	4.2	0.2	0.3	12.5	4.9	13.7	72	0.51	5.9	---	---	---	0.03
	27-45	R	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Deandale*	0-6	A1	11.3	4.0	0.2	0.6	16.1	3.8	15.7	81	1.07	6.6	---	1	1	0.93
(S81TX-009-007)	6-10	A2	11.6	4.5	0.7	0.3	17.1	3.3	17.5	84	0.79	6.9	---	---	---	0.13
	10-17	Bt1	19.7	10.6	3.0	0.6	33.9	5.1	33.4	87	0.78	7.5	---	---	---	0.15
	17-24	Bt2	28.4	10.9	4.1	0.5	43.9	---	30.0	---	0.56	8.2	TR	12	11	0.95
	24-37	Btk1	---	11.3	7.6	0.5	---	---	27.2	---	0.41	8.4	4	21	19	3.87
	37-45	Bty	---	11.3	9.6	0.4	---	---	27.0	---	0.26	7.9	4	18	16	9.64
	45-52	Bt3	---	11.0	9.8	0.5	---	---	26.5	---	0.21	8.1	7	23	20	7.28
	52-69	Bt4	---	9.0	8.3	0.4	---	---	21.9	---	0.12	8.2	11	23	20	6.82
	69-86	Btk2	---	7.2	6.6	0.3	---	---	17.1	---	0.08	8.3	11	24	20	6.22
	86-104	Btk3	18.2	7.1	7.2	0.3	32.8	---	19.1	---	0.07	8.0	TR	24	19	5.90
	104-110	Btkcb1	---	7.5	7.4	0.3	---	---	19.2	---	0.07	8.1	3	24	21	6.54
	110-120	Btb	---	5.7	5.7	0.2	---	---	13.6	---	0.07	8.2	3	24	20	5.62
	120-126	Cr	---	4.3	4.4	0.1	---	---	9.6	---	0.07	8.3	4	25	20	4.94
Kamay* ***	0-4	A1	4.5	2.5	0.2	0.7	7.9	3.3	7.5	71	0.74	5.7	---	---	---	0.24
(S81TX-009-006)	4-8	A2	6.5	4.7	0.6	0.4	12.2	2.8	12.4	81	0.60	6.9	---	---	---	0.11
	8-18	Bt1	11.8	11.8	3.8	0.5	27.9	3.2	26.7	90	0.71	7.9	---	12	11	1.17
	18-23	Btkc1	---	12.5	6.5	0.4	---	---	22.9	---	0.44	8.5	---	20	19	4.12
	23-38	Btkc2	---	12.3	8.8	0.4	---	---	21.9	---	0.28	8.1	---	22	19	9.13
	38-56	Btkc3	---	8.8	7.2	0.3	---	---	18.6	---	0.14	8.3	---	23	23	7.95
	56-62	Btkc4	---	9.1	7.5	0.3	---	---	17.9	---	0.13	8.4	---	27	24	6.95
	62-68	Btkc5	---	9.9	8.0	0.3	---	---	20.2	---	0.14	8.5	---	26	23	6.67
	68-73	2C	---	6.5	5.3	0.2	---	---	13.4	---	0.12	8.5	---	25	23	5.46
	82-88	4C	---	8.1	6.4	0.2	---	---	15.7	---	0.11	8.6	---	26	24	6.02

See footnotes at end of table.

TABLE 18.---CHEMICAL ANAYLSIS OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Extractable bases					Extractable acidity	CEC (sum of cations)	Base saturation (sum)	Organic carbon	pH 1:2 CaCl2	$CaCO_3$	ESP	SAR	Electrical conductivity
			Ca	Mg	Na	K	Sum									
	In		Milliequivalents/100 grams of soil							Pct	Pct		Pct	Pct		Mmhos/cm
Mangum*	0-3	A	18.2	9.2	2.4	2.0	31.8	4.5	29.5	88	1.56	6.8	---	8	TR	0.52
(S81TX-009-009)	3-14	Akc	---	10.9	0.3	0.9	---	---	27.3	---	0.68	8.0	TR	1	1	0.40
	14-21	Bkc1	---	12.0	0.8	0.6	---	---	25.3	---	0.52	8.2	2	2	2	0.61
	21-38	Bkc2	---	14.7	2.5	0.5	---	---	26.3	---	0.51	8.0	4	6	5	3.30
	38-54	Bkc3	---	16.9	3.8	0.6	---	---	26.7	---	0.44	7.9	4	8	7	4.84
	54-76	Ck	---	15.4	4.2	0.6	---	---	27.0	---	0.48	7.9	3	9	8	5.15
Rotan *, ****	0-5	A1	10.8	3.0	TR	1.4	15.2	4.1	15.1	79	1.59	6.3	---	TR	TR	1.27
(S81TX-009-008)	5-12	A2	15.9	4.7	0.2	1.3	22.1	3.3	21.6	87	1.05	6.9	---	---	---	0.14
	12-18	Bt1	20.4	6.8	0.3	1.2	28.7	3.1	27.9	90	0.79	7.3	---	---	---	0.15
	18-26	Bt2	19.9	7.5	0.5	0.9	28.8	2.9	28.0	91	0.64	7.7	TR	---	---	0.17
	26-34	Btk1	---	9.3	1.1	0.6	---	---	27.3	---	0.45	8.3	2	3	3	0.52
	34-43	Btk2	---	10.3	1.8	0.6	---	---	26.4	---	0.37	8.4	4	5	5	0.96
	43-51	Btkc1	---	10.4	2.4	0.6	---	---	24.7	---	0.25	8.3	10	7	6	1.59
	51-72	Btkc2	---	9.5	2.4	0.5	---	---	22.0	---	0.14	8.2	17	8	7	2.34
	72-93	Btkc3	---	8.3	2.5	0.5	---	---	21.3	---	0.11	8.2	18	8	7	2.55

* Locations of the sampled pedons are as follows:
Bluegrove: From State Highway 25 in Windthorst, 2.7 miles south on U.S. Highway 281, about 6.3 miles west on Farm Road 2581, about 0.45 mile south on an oil field road, 410 feet southeast of an oil well, in an area of rangeland.
Bonti: From State Highway 25 in Archer City, 9.3 miles south on State Highway 79, about 4.1 miles east on a county road, 3.4 miles south, 0.65 mile southwest, 1,000 feet northwest on a ranch road, 40 feet east in an area of rangeland.
Deandale: From U.S. Highway 82 in Mankins, 0.97 mile south on State Highway 25, about 400 feet southwest on a ranch road, 70 feet northwest in an area of rangeland.
Kamay: From U.S. Highway 82 in Dundee, 3.25 miles north on Farm Road 2846, about 0.9 mile west on an oil field road, 700 feet south on a ranchroad, across the dam of a pond, 700 feet south in an area of rangeland.
Mangum: From State Highway 25 in Archer City, 5.2 miles north on State Highway 79, about 2,200 feet east of a bridge, in an area of rangeland.
Rotan: From State Highway 25 in Mankins, 2.9 miles southwest on U.S. Highway 82, about 4.6 miles south on Farm Road 368, about 0.88 mile east on a county road, 0.22 mile south, 200 feet east of a road, in an area of rangeland.
** This Bonti pedon is a taxadjunct to the Bonti series because the clay content is less than 35 percent in the control section.
*** This Kamay pedon is a taxadjunct to the Kamay series because the clay mineralogy is mixed.
**** This Rotan pedon is a taxadjunct to the Rotan series because the clay mineralogy is montmorillonitic.

TABLE 19.--CLAY MINERALOGY OF SELECTED SOILS

(Dashes indicate that material was not detected)

Soil name and sample number	Depth	Horizon	Clay mineralogy and relative amounts*					
			Montmorillonite	Mica	Kaolinite	Quartz	Chlorite	Vermiculite
	In		Pct	Pct	Pct	Pct	Pct	Pct
Bluegrove**	0-4	A	1	2	3	---	---	---
(S81TX-009-010)	10-17	Bt2	3	3	4	---	---	---
Bonti** ***	0-4	A1	1	2	3	1	---	---
(S81TX-009-011)	8-14	Bt1	3	3	3	---	---	---
Deandale**	6-10	A2	4	3	3	1	---	---
(S81TX-009-007)	10-17	Bt1	4	3	3	---	2	---
	37-45	Bty	3	2	2	1	---	---
	104-110	Btkcb1	3	3	3	---	1	---
	120-126	Cr	3	3	4	1	---	---
Kamay** ****	0-4	A1	2	2	2	1	---	---
(S81TX-009-006)	8-18	Bt1	4	3	3	---	2	---
	62-68	Btkc5	4	3	3	---	1	---
	68-73	2C	4	3	3	---	---	---
Mangum**	3-14	Akc	3	3	3	---	1	---
(S81TX-009-009)	54-76	Ck	3	3	3	---	1	---
Rotan** *****	5-12	A2	4	3	2	1	---	---
(S81TX-009-008)	18-26	Bt2	3	2	2	1	---	---
	72-93	Btkc3	4	3	3	1	---	---

* Relative amounts: 1, trace; 2, small; 3, moderate; and 4, abundant.

** Locations of the sampled pedons are as follows:

Bluegrove: From State Highway 25 in Windthorst, 2.7 miles south on U.S. Highway 281, about 6.3 miles west on Farm Road 2581, about 0.45 mile south on an oil field road, 410 feet southeast of an oil well, in an area of rangeland.

Bonti: From State Highway 25 in Archer City, 9.3 miles south on State Highway 79, about 4.1 miles east on a county road, 3.4 miles south, 0.65 mile southwest, 1,000 feet northwest on a ranch road, 40 feet east in an area of rangeland.

Deandale: From U.S. Highway 82 in Mankins, 0.97 mile south on State Highway 25, about 400 feet southwest on a ranch road, 70 feet northwest in an area of rangeland.

Kamay: From U.S. Highway 82 in Dundee, 3.25 miles north on Farm Road 2846, about 0.9 mile west on an oil field road, 700 feet south on a ranch road, across the dam of a pond, 700 feet south in an area of rangeland.

Mangum: From State Highway 25 in Archer City, 5.2 miles north on State Highway 79, about 2,200 feet east of a bridge, in an area of rangeland.

Rotan: From State Highway 25 in Mankins, 2.9 miles southwest on U.S. Highway 82, about 4.6 miles south on Farm Road 368, about 0.88 mile east on a county road, 0.22 mile south, 200 feet east of a road, in an area of rangeland.

*** This Bonti pedon is a taxadjunct to the Bonti series because the clay content is less than 35 percent in the control section.

**** This Kamay pedon is a taxadjunct to the Kamay series because the clay mineralogy is mixed.

***** This Rotan pedon is a taxadjunct to the Rotan series because the clay mineralogy is montmorillonitic.

TABLE 20.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Specific gravity	Shrinkage		
			Percentage passing sieve--				Percentage smaller than--									
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm	.001 mm				Limit	Linear	Ratio
											Pct			Pct	Pct	
Bluegrove fine sandy loam* (S81TX-009-010)																
A1-------- 0 to 6	A-4(0)	SM-SC	100	100	99	38	36	12	9	6	23	4	2.67	20	1.7	1.73
Bt1------- 6 to 15	A-6(9)	CL	100	100	99	58	55	34	29	26	35	19	2.63	18	8.8	1.79
Bt2------- 15 to 25	A-7-6(21)	CL	100	100	98	73	70	54	49	46	48	28	2.64	16	14.6	1.86
BC-------- 25 to 37	A-6(9)	CL	100	100	100	57	45	34	31	28	35	19	2.65	19	7.8	1.76
Bonti fine sandy loam* ** (S80TX-009-003)																
A1-------- 0 to 6	A-4(0)	SM-SC	100	100	96	41	31	10	7	6	24	5	2.61	19	2.8	1.76
Bt1------- 6 to 18	A-6(8)	CL	100	100	96	57	55	43	36	35	36	19	2.60	17	8.2	1.83
Bt2------- 18 to 25	A-6(4)	SC	100	99	94	48	45	25	22	17	33	16	2.62	18	7.8	1.80
BC-------- 25 to 37	A-2-6(1)	SC	99	95	84	34	31	25	23	22	32	17	2.66	17	7.5	1.82
Deandale silt loam* (S80TX-009-002)																
Ap--------- 0 to 4	A-4(5)	CL-ML	100	100	100	88	70	20	16	14	24	7	2.57	19	2.8	1.78
Bt1-------- 8 to 18	A-7-6(34)	CH	100	100	100	92	85	51	44	41	53	33	2.61	15	16.2	1.93
Btk2------- 45 to 64	A-6(20)	CL	98	96	94	82	72	38	33	28	39	25	2.68	13	12.8	2.03
Btk3------- 64 to 76	A-6(15)	CL	98	97	96	77	66	36	19	26	34	20	2.70	15	9.9	1.93
Jolly fine sandy loam*** (S80TX-009-004)																
A--------- 0 to 5	A-4(1)	ML	100	100	100	54	45	16	13	11	30	5	2.57	25	2.7	1.61
Bt1------- 5 to 11	A-6(4)	CL	99	98	98	54	45	29	25	22	29	12	2.57	20	4.8	1.78
Bt2------- 11 to 18	A-6(4)	SC	100	100	99	37	34	26	23	20	31	13	2.59	19	6.8	1.79
Jolly fine sandy loam* (S83TX-009-001)																
A---------- 0 to 5	A-4(0)	SM-SC	100	100	99	43	34	20	16	14	25	6	2.65	15	4.1	1.76
Bt--------- 5 to 13	A-6(7)	CL	100	100	99	51	46	36	32	28	37	19	2.71	18	9.7	1.83
CB--------- 13 to 24	A-2-4(0)	SC	100	100	100	30	30	22	17	16	28	8	2.67	20	3.2	1.73

TABLE 20.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Specific gravity	Shrinkage		
			Percentage passing sieve--				Percentage smaller than--									
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm	.001 mm				Limit	Linear	Ratio
											Pct			Pct	Pct	
Kamay silt loam* (S81TX-009-003)																
A1--------- 0 to 7	A-4(3)	CL-ML	100	100	100	81	72	18	14	12	22	5	2.62	17	3.2	1.79
Bt1-------- 7 to 16	A-7-6(26)	CL	100	100	100	88	86	47	42	37	44	28	2.61	13	14.5	1.95
Bt2-------- 16 to 27	A-7-6(22)	CL	100	99	98	84	77	42	37	32	41	26	2.64	12	14.0	1.99
Btk1------- 50 to 67	A-6(9)	CL	99	98	97	64	62	31	25	21	30	17	2.66	14	8.7	1.95
Btk2------- 67 to 80	A-6(8)	CL	86	73	60	50	47	26	20	17	37	24	2.69	12	12.7	2.00
Knoco clay* (S81TX-009-004)																
A---------- 0 to 8	A-6(8)	CL	95	86	80	63	62	38	28	22	32	18	2.70	12	10.6	2.03
Cr--------- 8 to 60	A-7-6(27)	CL	100	100	100	99	98	98	52	26	43	25	2.70	15	13.7	2.05
Vernon clay* (S81TX-009-005)																
A---------- 0 to 5	A-7-6(32)	CH	99	97	95	90	84	66	56	48	51	32	2.70	9	18.2	2.05
Bk--------- 5 to 16	A-7-6(39)	CH	99	97	95	91	83	67	57	49	59	39	2.74	9	20.8	2.10
C---------- 16 to 60	A-7-6(28)	CL	98	96	95	91	89	61	41	28	48	29	2.74	13	16.1	2.00
Westfork silty clay*** (S81TX-009-002)																
A1--------- 0 to 6	A-7-6(35)	CH	100	100	100	98	97	70	54	43	51	31	2.66	17	14.8	1.85
A2--------- 6 to 16	A-7-6(31)	CL	100	100	100	98	96	65	50	39	48	27	2.64	15	15.1	1.93
Bw1-------- 16 to 21	A-7-6(28)	CL	100	100	100	97	95	62	47	36	44	26	2.68	13	14.5	1.96
Bw2-------- 21 to 28	A-7-6(28)	CL	100	100	100	97	93	61	47	36	45	27	2.67	13	15.2	1.99
Bw3-------- 28 to 38	A-7-6(32)	CL	100	100	100	98	97	66	45	40	47	29	2.67	12	16.0	2.01
Bw4-------- 38 to 45	A-7-6(33)	CL	100	100	100	98	97	63	51	41	47	30	2.66	12	16.3	2.03
Bk--------- 45 to 57	A-7-6(30)	CL	100	100	100	97	94	63	49	39	45	28	2.72	11	16.0	2.03
Bw5-------- 57 to 80	A-7-6(35)	CH	100	100	100	97	96	68	52	40	50	32	2.68	13	17.2	2.02
Wheatwood silt loam* (S80TX-009-005)																
Ap--------- 0 to 6	A-4(8)	CL	100	100	100	85	63	22	17	14	27	10	2.66	19	4.2	1.76
Bw1-------- 6 to 16	A-6(8)	CL	100	100	100	85	76	22	18	16	27	11	2.68	18	5.0	1.80
Bw2-------- 16 to 24	A-4(6)	CL	100	100	100	85	64	20	17	14	26	8	2.63	20	3.2	1.76
C2--------- 34 to 80	A-4(6)	CL-ML	100	100	100	87	62	18	13	11	25	7	2.67	19	3.6	1.77

TABLE 20.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Specific gravity	Shrinkage		
			Percentage passing sieve--				Percentage smaller than--									
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm	.001 mm				Limit	Linear	Ratio
											Pct			Pct	Pct	
Winters loam*** (S80TX-009-001)																
A1--------- 0 to 5	A-4(5)	CL-ML	100	100	100	84	66	16	13	11	25	7	2.60	19	3.2	1.73
A2--------- 5 to 11	A-4(5)	CL-ML	100	100	100	84	67	20	18	16	27	6	2.64	21	2.8	1.72
Bt1-------- 11 to 21	A-7-6(24)	CL	100	100	100	88	67	45	40	36	42	26	2.67	15	12.9	1.90
Bt4-------- 51 to 68	A-6 (10)	CL	100	100	100	78	58	27	21	11	27	14	2.67	17	5.8	1.85

* Locations of the sampled pedons are as follows:
Bluegrove: From State Highway 79 in Archer City, 2.4 miles east on State Highway 25, about 4.9 miles southeast on Farm Road 2581, about 0.45 mile south on an oil field road, 410 feet southeast of an oil well in an area of rangeland.
Bonti: From State Highway 25 in Archer City, 9.3 miles south on State Highway 79, about 4.1 miles east on a county road, 3.4 miles south, 1.2 miles southwest, 0.2 mile northwest on a ranch road, 490 feet north in an area of rangeland.
Deandale: From U.S. Highway 82 in Holliday, 1.7 miles south on Farm Road 368, about 4.7 miles east on Farm Road 1954, about 400 feet north and 600 feet east in a area of cropland.
Jolly: From intersection of Farm Roads 210 and 422, about 10.3 miles north of Megargel, 1.44 miles south on Farm Road 210, about 3,000 feet east in an area of rangeland.
Kamay: From U.S. Highway 82 in Dundee, 3.25 miles north on Farm Road 2846, about 0.9 mile west on an oil field road, 700 feet south on a ranch road, across the dam of a pond, 700 feet south in an area of rangeland.
Knoco: From State Highway 25 in Archer City, 5.25 miles north on State Highway 79, about 0.95 mile northwest on a county road, 650 feet south, 2,900 feet west along a fence, 910 feet southwest alongside a ranch trail.
Vernon: From State Highway 79 in Archer City, 2.7 miles west on State Highway 25, about 9.7 miles west on Farm Road 210, about 3.1 miles west on Farm Road 422, about 0.72 mile north on a ranch road, 0.24 mile west, 24 feet south in an area of rangeland. Wheatwood: From State Highway 25 in Archer City, 4.73 miles north on State Highway 79, about 1.12 miles east, south, and east on an oil field road, 120 feet north in an area of cropland.

** This Bonti pedon is a taxadjunct to the Bonti series because the content of clay is less than 35 percent in the control section.

*** Location of the pedon sampled is the same as that of the typical pedon described in the section "Soil Series and Their Morphology."

TABLE 21.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Aspermont	Fine-silty, mixed, thermic Typic Ustochrepts
Bluegrove	Fine, mixed, thermic Typic Haplustalfs
Bonti	Fine, mixed, thermic Ultic Paleustalfs
Darnell	Loamy, siliceous, thermic, shallow Udic Ustochrepts
Deandale	Fine, montmorillonitic, thermic Pachic Paleustolls
Exray	Clayey, mixed, thermic Lithic Rhodustalfs
Gracemore	Sandy, mixed, thermic Aquic Udifluvents
Grandfield	Fine-loamy, mixed, thermic Typic Haplustalfs
Hollister	Fine, mixed, thermic Pachic Paleustolls
Jolly	Loamy, siliceous, thermic, shallow Typic Haplustalfs
Kamay	Fine, montmorillonitic, thermic Typic Paleustalfs
Knoco	Clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents
Latom	Loamy, mixed (calcareous), thermic Lithic Ustic Torriorthents
Mangum	Fine, mixed, thermic Vertic Ustochrepts
Port	Fine-silty, mixed, thermic Cumulic Haplustolls
*Rotan	Fine, mixed, thermic Pachic Paleustolls
Rowden	Fine, mixed, thermic Typic Argiustolls
Tillman	Fine, mixed, thermic Typic Paleustolls
Vernon	Fine, mixed, thermic Typic Ustochrepts
Westfork	Fine, mixed, thermic Cumulic Haplustolls
Weswind	Fine, mixed, thermic Typic Paleustalfs
Wheatwood	Fine-silty, mixed, thermic Fluventic Ustochrepts
Wichita	Fine, mixed, thermic Typic Paleustalfs
Windthorst	Fine, mixed, thermic Udic Paleustalfs
Winters	Fine, mixed, thermic Typic Paleustalfs
Yomont	Coarse-silty, mixed (calcareous), thermic Typic Ustifluvents

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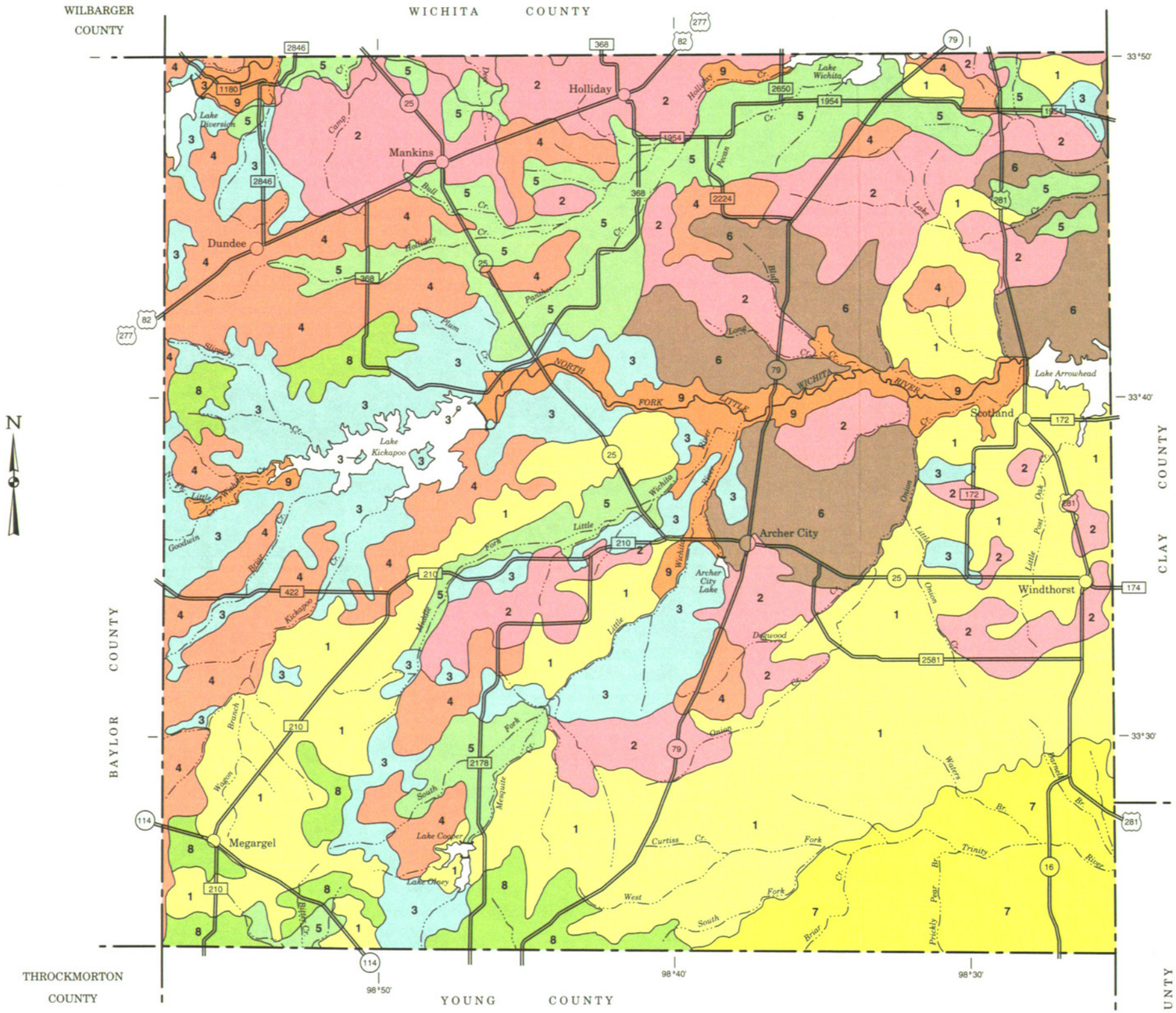


SOIL LEGEND *

1	Bluegrove - Jolly - Weswind
2	Kamay - Deandale
3	Vernon - Knoco
4	Tillman - Vernon
5	Winters - Deandale
6	Bluegrove - Kamay
7	Windthorst - Bonti - Darnell
8	Rotan - Tillman
9	Wheatwood - Mangum

*** The units on this legend are described in the text under the heading " General Soil Map Units. "**

Compiled 1994

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION
TEXAS STATE SOIL AND WATER CONSERVATION BOARD

GENERAL SOIL MAP

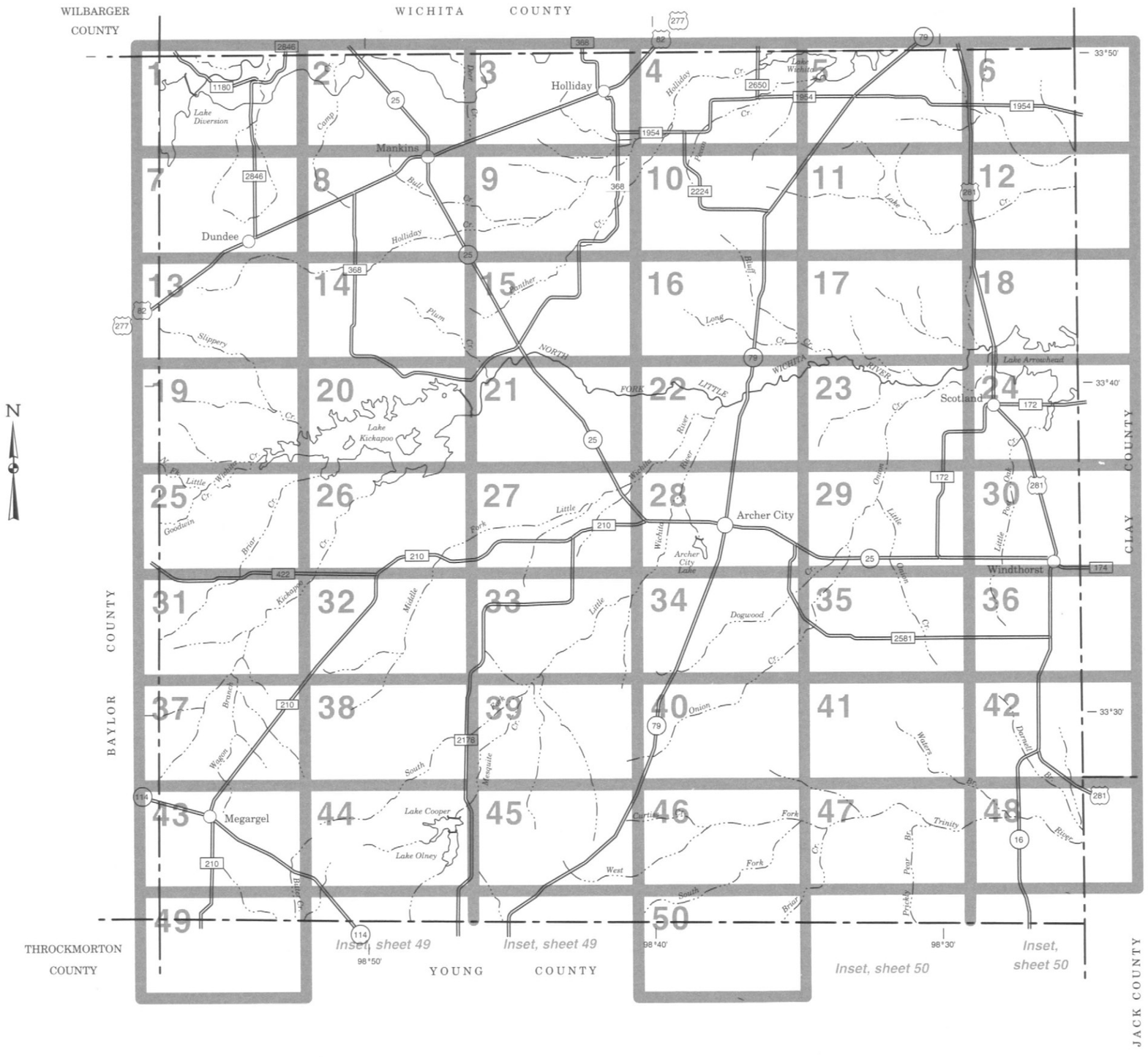
ARCHER COUNTY, TEXAS

Scale 1 : 253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



All text from each individual map sheet read:

This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS

ARCHER COUNTY, TEXAS

Scale 1 : 253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

Soil map publication symbols and map unit names are listed alphabetically. Map symbols consist of a combination of letters or of letters and a number. The first letter is always a capital and is the initial letter of the soil name. The second letter is lowercase, except for the broadly defined unit, in which case it is a capital. The third letter, when used, is a capital and denotes slope class. Symbols without a slope letter are for nearly level flood plain soils or for miscellaneous areas. The number 3 indicates that the soil is moderately eroded. Symbols without a number indicate that the soil is not eroded or is only slightly eroded.

SYMBOL	NAME
AsC3	Aspermont clay loam, 1 to 5 percent slopes, eroded
Ba	Badland
BeB	Bluegrove fine sandy loam, 1 to 5 percent slopes
BtC	Bonti fine sandy loam, 1 to 5 percent slopes
DaD	Darnell-Exray complex, 2 to 15 percent slopes, stony
DeA	Deandale loam, 0 to 1 percent slopes
DeB	Deandale loam, 1 to 3 percent slopes
DnA	Deandale silt loam, 0 to 1 percent slopes
DnB	Deandale silt loam, 1 to 3 percent slopes
DsA	Deandale silt loam, loamy substratum, 0 to 1 percent slopes
Gm	Gracemore fine sandy loam, frequently flooded
GrC	Grandfield fine sandy loam, 1 to 5 percent slopes
HoA	Hollister silty clay loam, 0 to 1 percent slopes
HoB	Hollister silty clay loam, 1 to 3 percent slopes
JoC	Jolly-Rock outcrop complex, 2 to 12 percent slopes, stony
KaA	Kamay silt loam, 0 to 1 percent slopes
KaB	Kamay silt loam, 1 to 3 percent slopes
KDA	Kamay-Deandale association, saline, 0 to 2 percent slopes
KvD	Knoco-Vernon complex, 2 to 12 percent slopes
KvE	Knoco-Vernon complex, 10 to 45 percent slopes, very bouldery
Ma	Mangum clay, occasionally flooded
Mc	Mangum clay, frequently flooded
Mw	Mangum-Wheatwood complex, occasionally flooded
Ow	Oil-waste land
Po	Port-Wheatwood complex, occasionally flooded
Pw	Port and Wheatwood soils, frequently flooded
RoA	Rotan silty clay loam, 0 to 1 percent slopes
RoB	Rotan silty clay loam, 1 to 3 percent slopes
RwB	Rowden clay loam, 1 to 3 percent slopes
TcA	Tillman clay loam, 0 to 1 percent slopes
TcB	Tillman clay loam, 1 to 3 percent slopes
VeC	Vernon clay, 1 to 5 percent slopes
VkD	Vernon-Knoco complex, 2 to 8 percent slopes
VlD	Vernon-Latom complex, 3 to 12 percent slopes, stony
Wc	Westfork silty clay, occasionally flooded
WdC	Weswind fine sandy loam, 1 to 5 percent slopes
We	Wheatwood silt loam, occasionally flooded
WhA	Wichita clay loam, 0 to 1 percent slopes
WhB	Wichita clay loam, 1 to 3 percent slopes
WlC	Windthorst fine sandy loam, 1 to 5 percent slopes
WnA	Winters loam, 0 to 1 percent slopes
WnB	Winters loam, 1 to 3 percent slopes
Yo	Yomont very fine sandy loam, occasionally flooded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES
- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline
- AD HOC BOUNDARY (label) (Davis Airstrip)
- Small airport, airfield, park, oilfield, cemetery, or flood pool (FLOOD POOL LINE)

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER
(sections and land grants)

ROADS
- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS
- Interstate (173)
- Federal (287)
- State (52)
- County, farm or ranch (1283)

RAILROAD

POWER TRANSMISSION LINE
(normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES
- Without road
- With road
- With railroad

DAMS
- Large (to scale)
- Medium or Small (Named where applicable) (water)

PITS
- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES
- Farmstead, house (omit in urban area) (occupied)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (Gas)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE
- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS
- Perennial (water)
- Intermittent (int)

MISCELLANEOUS WATER FEATURES
- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (TcA TcB)

ESCARPMENTS
- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

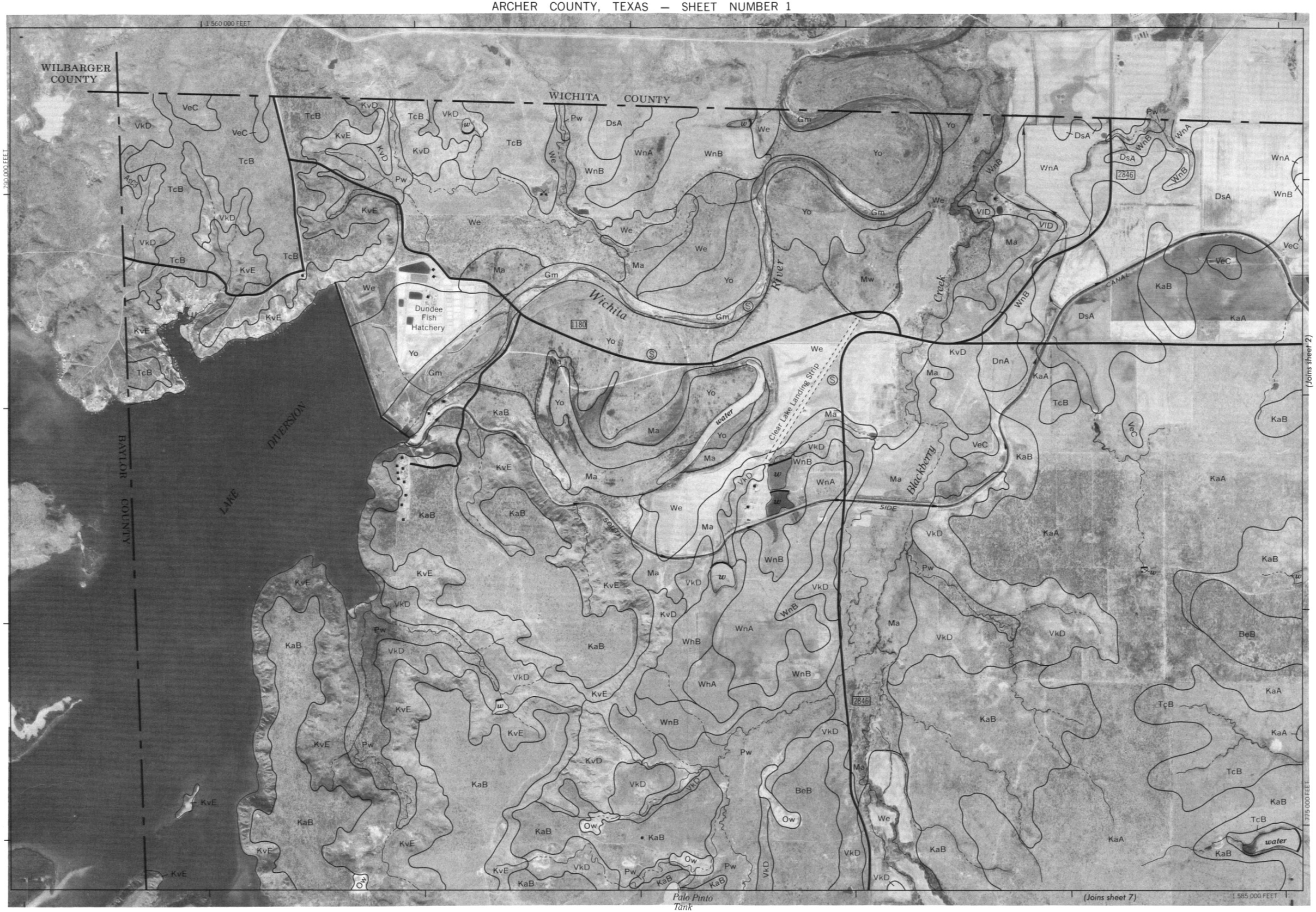
GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

MISCELLANEOUS
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

ARCHER COUNTY, TEXAS — SHEET NUMBER 1



ARCHER COUNTY, TEXAS — SHEET NUMBER 2

2

N

10000 Feet 3 Kilometers

5000 2 1

Scale - 1:24000

5000 4000 3000 2000 1000 0 0 .5 1

1 615 000 FEET

1 585 000 FEET

1 575 000 FEET

WICHITA COUNTY

Camp Creek

SOUTH SIDE CANAL

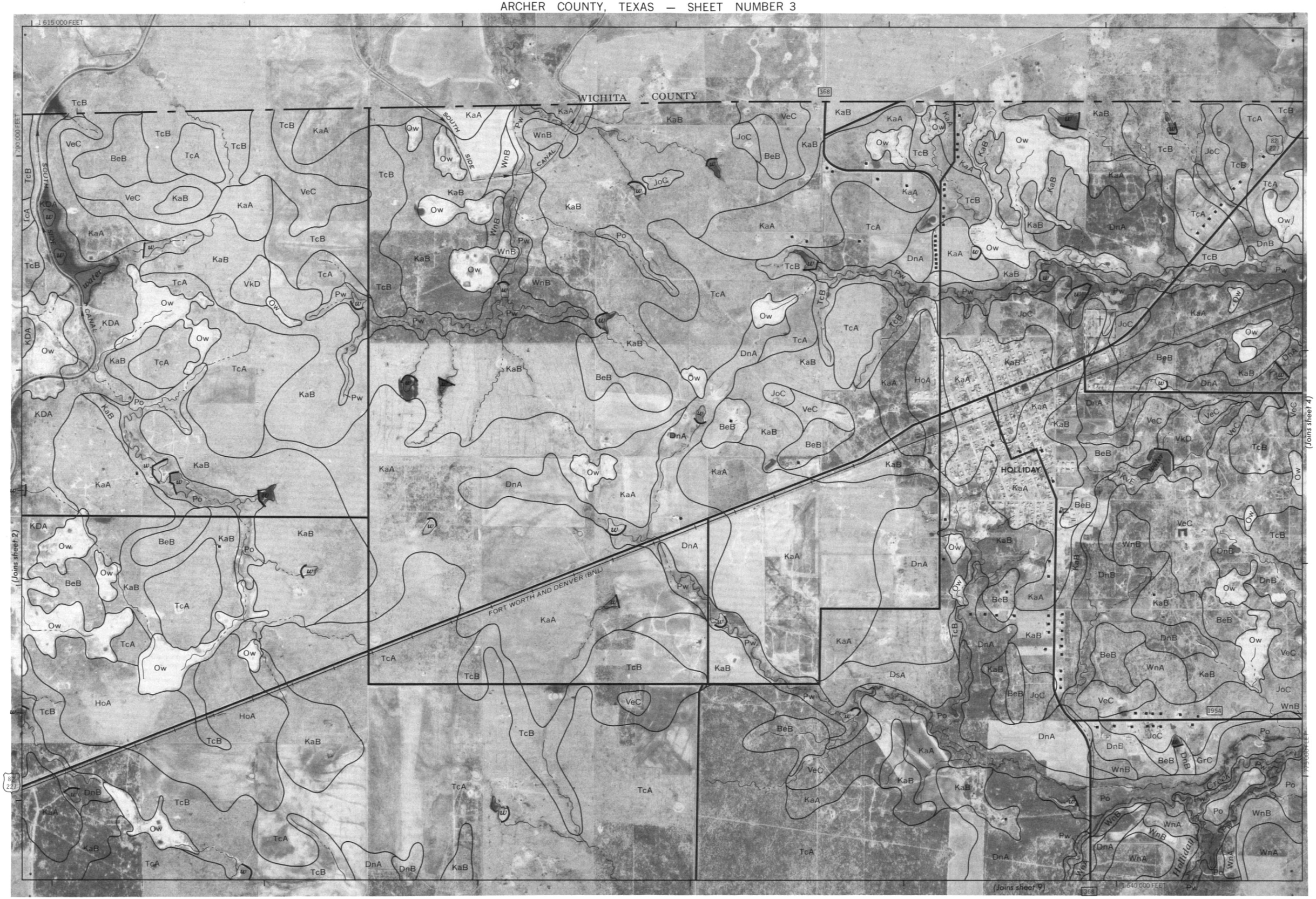
FORT WORTH AND DENVER RWY

(Joins sheet 1)

(Joins sheet 8)

(Joins sheet 3)

ARCHER COUNTY, TEXAS — SHEET NUMBER 3



Coordinate grid ticks and division corners, if shown, are approximately positioned.

4

N

Scale - 1:24000

10000 Feet 3 Kilometers 5000 2 0 1000 .5 0 2000 1 1 3000 4000 5000

WICHITA COUNTY

LAKE WICHITA

FORT WORTH AND DENVER (BNL)

Creek

Pecan Creek

Holliday Creek

Panther Creek

Pecan Creek

1670000 FEET

2650

1954

2274

1645000 FEET

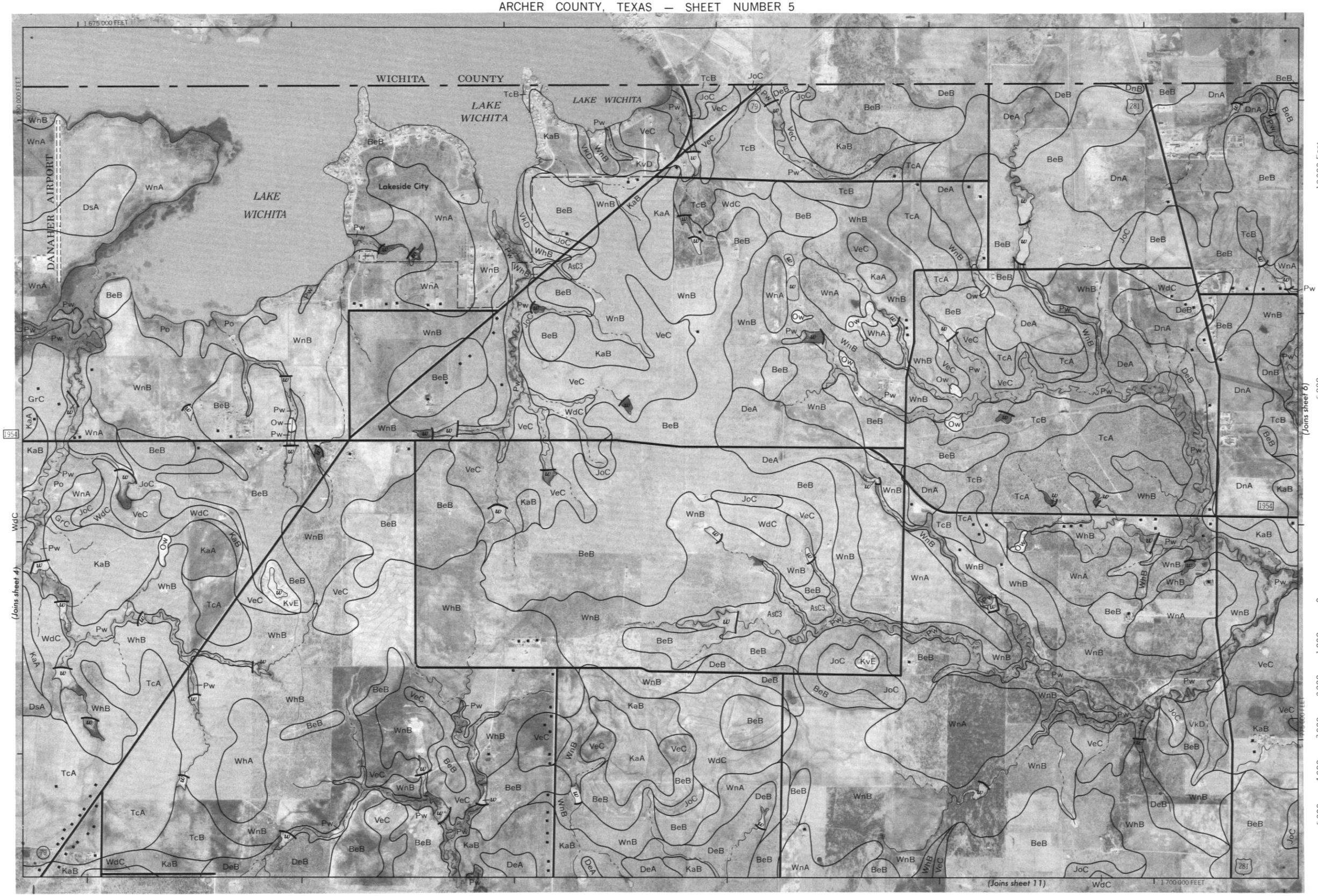
(Joins sheet 10)

(Joins sheet 5)

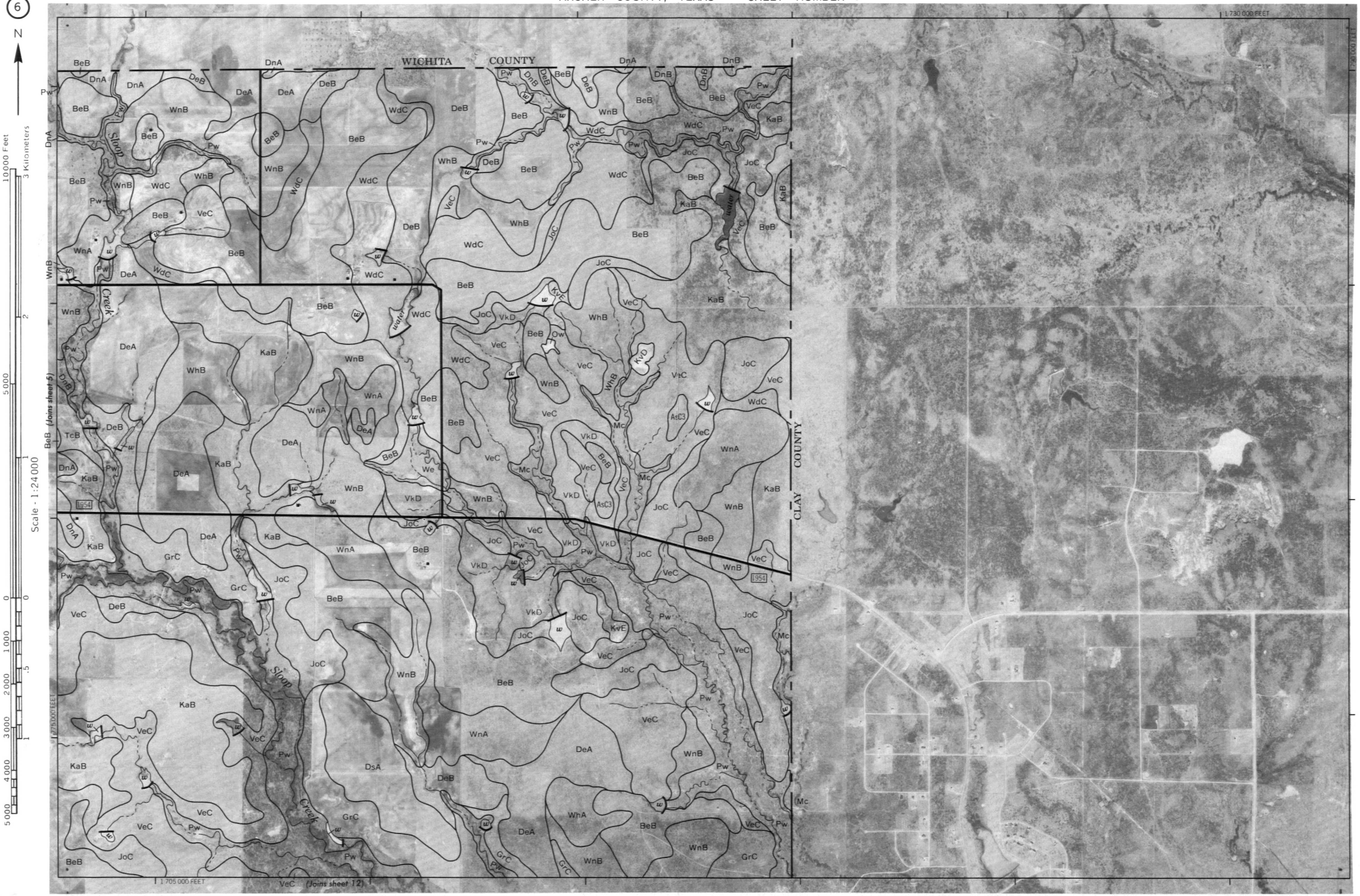
(Joins sheet 3)

TcB TcA KaA KaB KDA VeC Mw Ma Ow Pw WnB WnA DnB KaA Po DnA VeC KaB DsA KvD TcB WhB BeB JoC HoA AsC WdC GrC TcA VeC

ARCHER COUNTY, TEXAS — SHEET NUMBER 5



Coordinate grid ticks and land division corners, if shown, are approximately positioned



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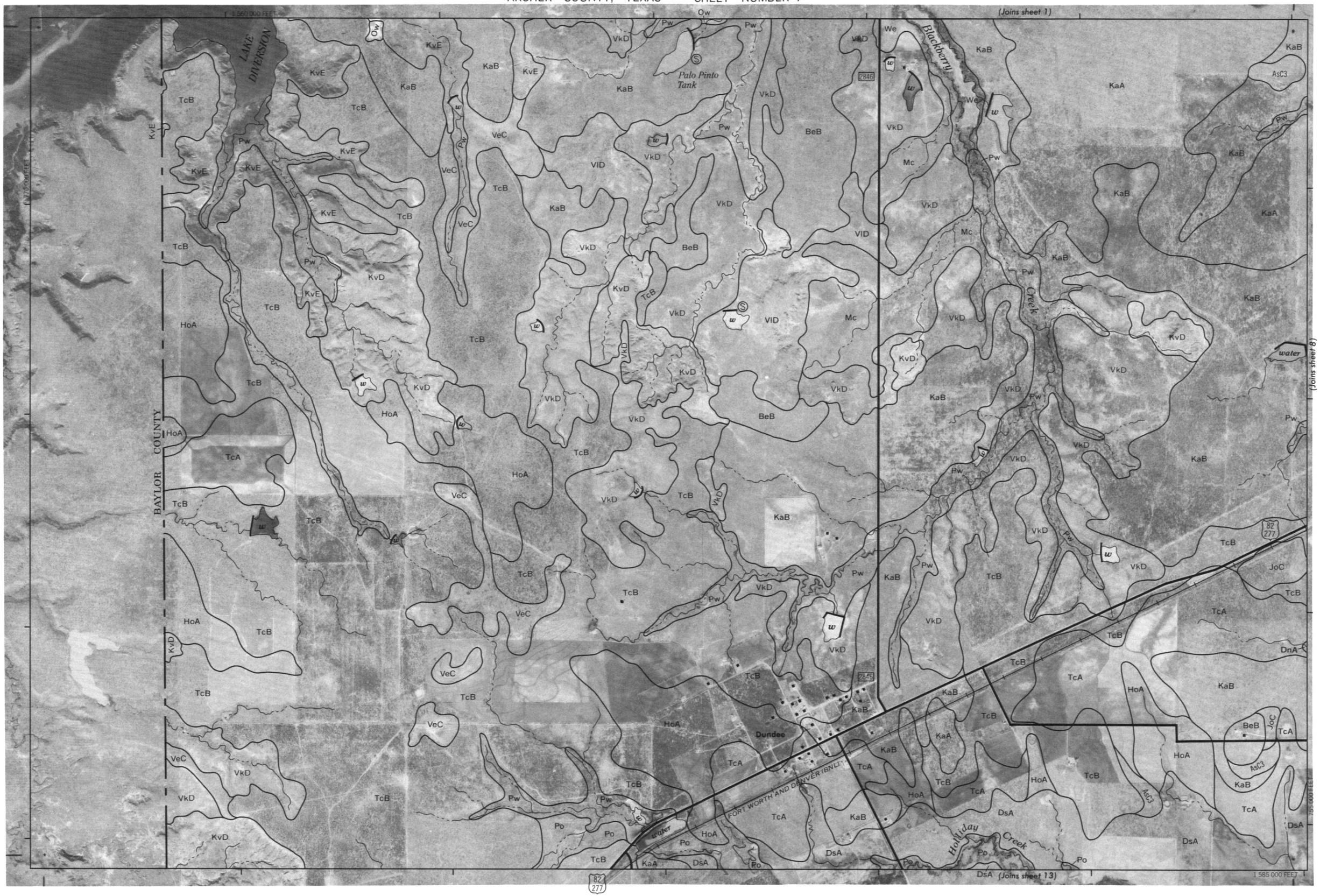


7

N

10000 Feet

3 Kilometers

Scale - 1:24000

8

N

Scale - 1:24 000

10 000 Feet 5 000 0

3 Kilometers 2 1 0

(Joins sheet 2)

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 14)

1 610 000 FEET

1 595 000 FEET

Mankins

FORT WORTH AND DENVER (BNLI)

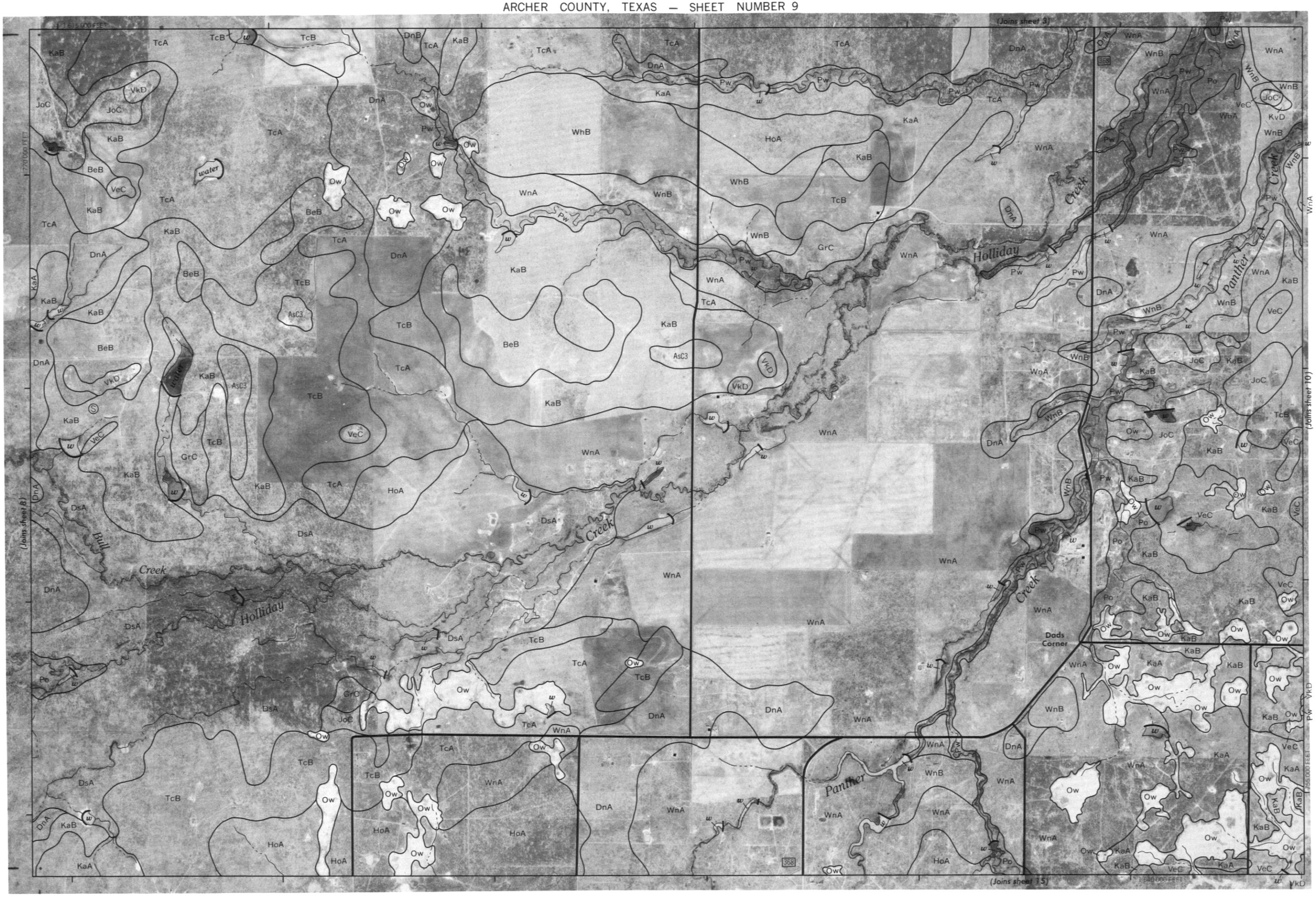
Bull Creek

Holliday Creek

82 277

368

ARCHER COUNTY, TEXAS — SHEET NUMBER 9



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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

9

N

Scale - 1:24000

10000 Feet 5000

3 Kilometers 2 1 0

ARCHER COUNTY, TEXAS — SHEET NUMBER 10

10

N

Scale - 1:24000

10,000 Feet 3 Kilometers

5,000 2 1

0 .5 0

1 000 2 000 3 000 4 000 5 000 1

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 16)

(Joins sheet 11)

1 670 000 FEET

1 755 000 FEET

1 645 000 FEET

Panther Creek

Bluff Creek

water

2224

79

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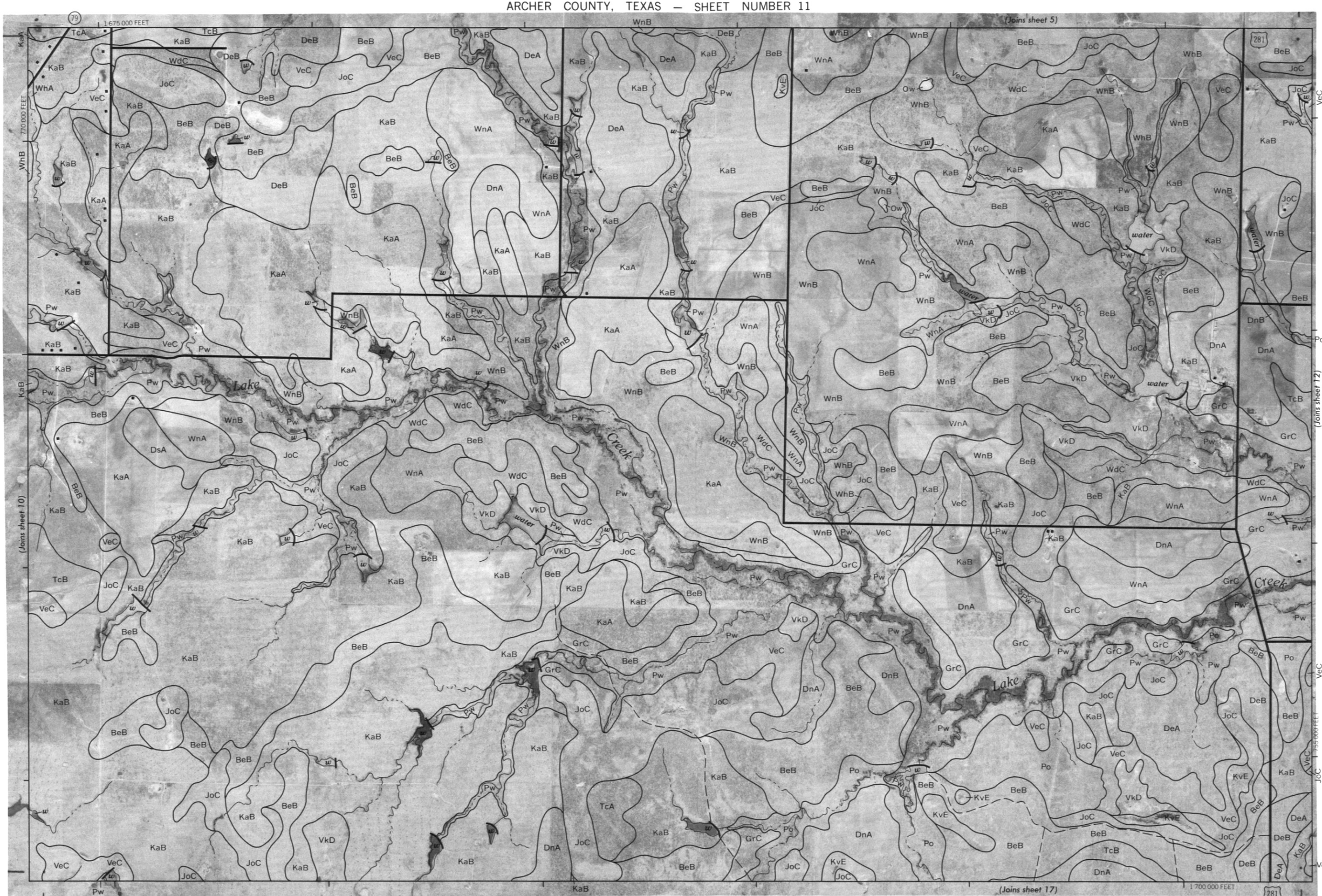

(Joins sheet 5)
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 17)
1 675 000 FEET
770 000 FEET
1 700 000 FEET
755 000 FEET
Lake
Creek
water
281
79
N
Scale - 1:24 000
10000 Feet
5000
3 Kilometers
2
1
0
.5
1000
2000
3000
4000
5000

12

N

Scale - 1:24000

10000 Feet 5000 0

3 Kilometers 2 1 0 .5 1

(Joins sheet 6)

(Joins sheet 11)

(Joins sheet 18)

1 730 000 FEET

1 705 000 FEET

755 000 FEET

770 000 FEET

CLAY COUNTY

Sloop

Sloop Pond

Creek

Lake

water

BeB DnA DnB DeA DeB GrC JoC KaB KvE Ow Po Pw TcA TcB VeC VkD WdC We WnA WnB

1 560 000 FEET

1 750 000 FEET

(Joins sheet 7)

(Joins sheet 19)

(Joins sheet 14)

1 580 000 FEET

736 000 FEET

BAYLOR COUNTY

FORT WORTH AND DENVER RAILWAY

Holliday Creek

Johnson Draw

Slippery Creek

DUNDEE CEMETERY

13

N

10000 Feet

3 Kilometers

Scale - 1:24000

14

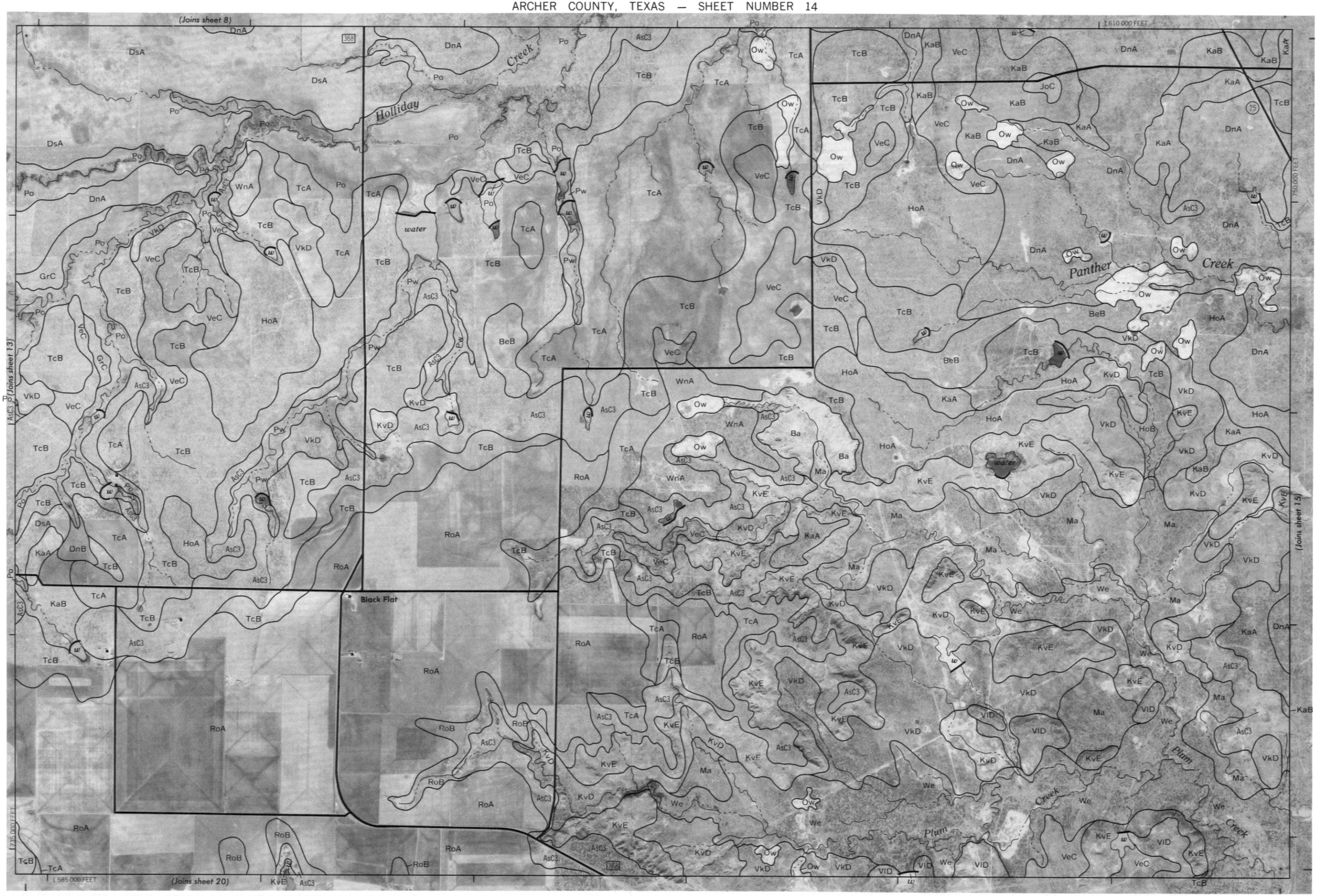
N

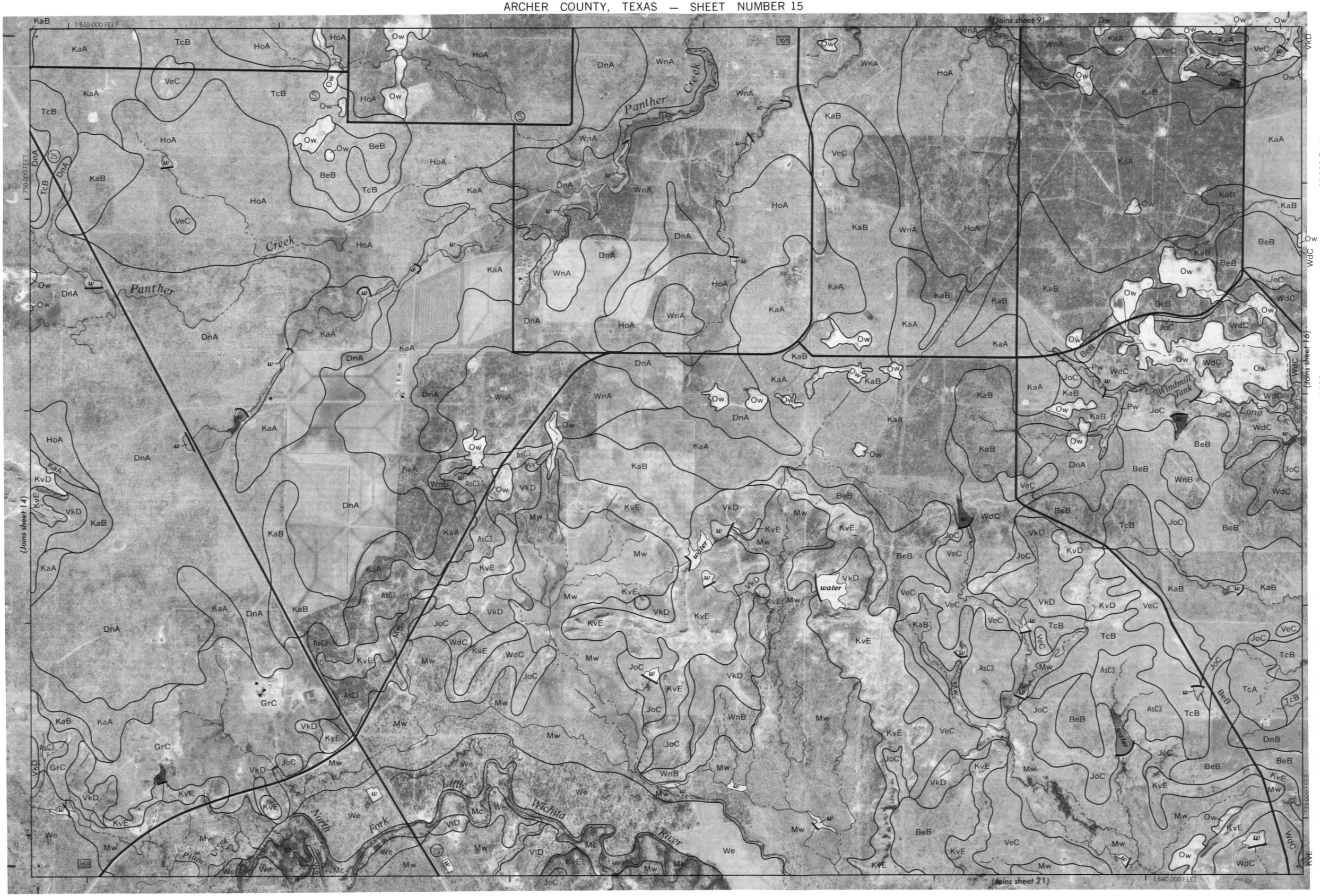
10000 Feet 3 Kilometers

5000 2 1

Scale - 1:24 000

0 0 1000 .5 2000 3000 1 4000 5000




1 615 000 FEET
(Joins sheet 9)
(Joins sheet 16)
(Joins sheet 14)
(Joins sheet 21)
1 640 000 FEET
1 735 000 FEET
750 000 FEET
Panther Creek
Windmill Tank
Long Cr.
Little Wichita River
North Fork
Plum Creek
water
15
N
10 000 Feet
3 Kilometers
Scale - 1:24000

ARCHER COUNTY, TEXAS — SHEET NUMBER 16


1 675 000 FEET
1 750 000 FEET
(Joins sheet 11)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 23)
1 700 000 FEET
Old Tank
Clear Tank
Red Tank
Mexican Tank
Bluff Creek
Little Wichita River
Wichita River
water
KaB
VeC
JoC
BeB
DnA
TcB
TcA
WdC
GrC
Po
KvE
DeB
DeA
WnB
DnB
Pw
VkD
KaA
WnA
AsC3
Mc
Mw
We
Ma
Ow
281
N
10000 Feet
3 Kilometers
2
1
5000
0
1000
.5
2000
3000
4000
5000
Scale - 1:24000

18

N

Scale - 1:24000

10000 Feet 3 Kilometers 5000 2 1 0 0 1000 2000 3000 4000 5000 .5 1

1 730 000 FEET

(Joins sheet 12)

(Joins sheet 17)

(Joins sheet 24)

281

COUNTY

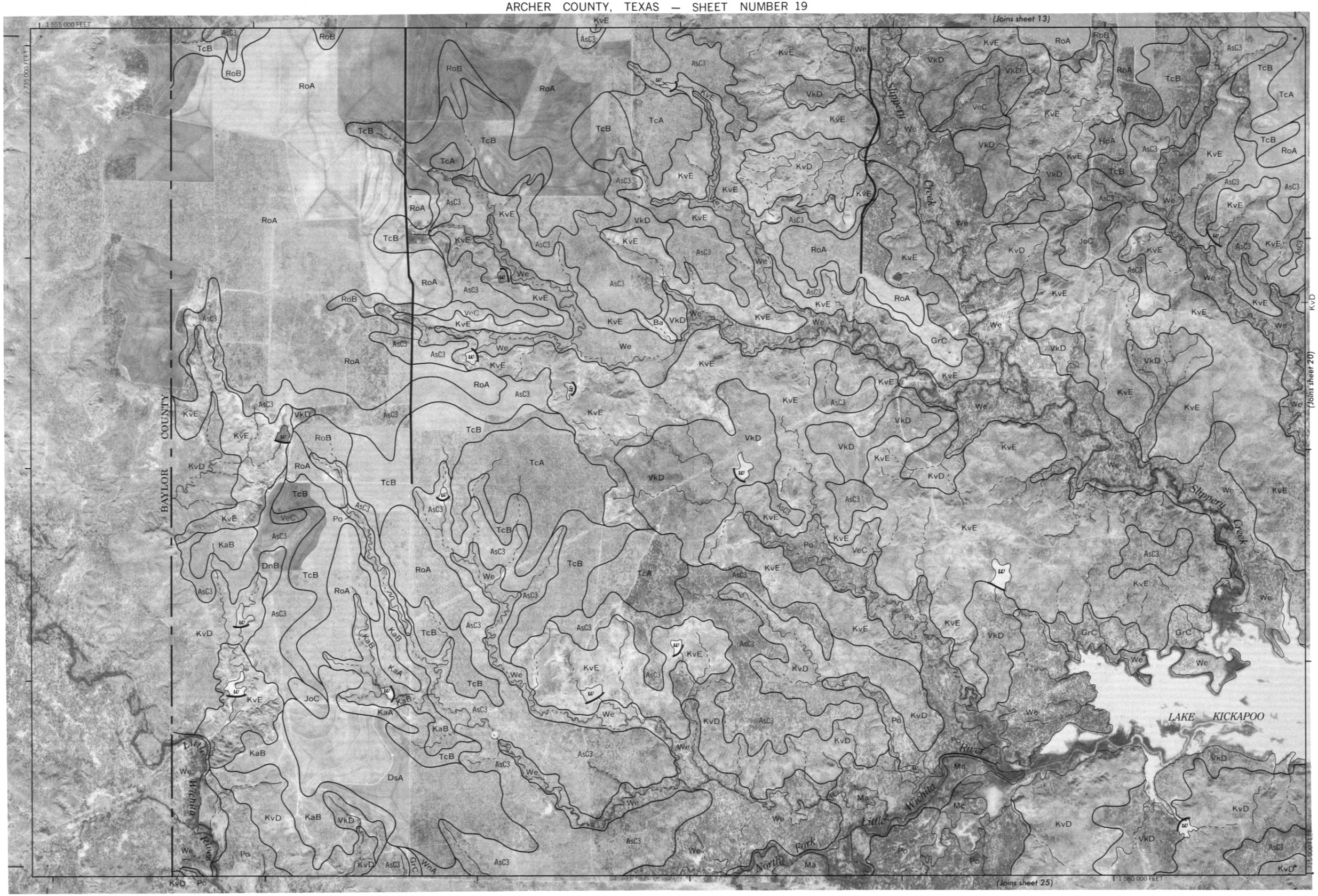
CLAY

LAKE ARROWHEAD

Lake Arrowhead

Little Wichita River

BeB DeB DeA TcA VeC KaB DnA DnB WnB JoC KvD KvE Mc Mw TcB VkD WdC WhB We Pw GrC Ma



19

N

10000 Feet
3 Kilometers

Scale - 1:24000

20

N

Scale - 1:24 000

10000 Feet 5000 0 1000 2000 3000 4000 5000

3 Kilometers 2 1 0 .5 1

(Joins sheet 14)

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 26)

1 640 000 FEET

1 585 000 FEET

2 115 000 FEET

KICKAPOO LAKE

Pancake Island

Long Island

Council Island

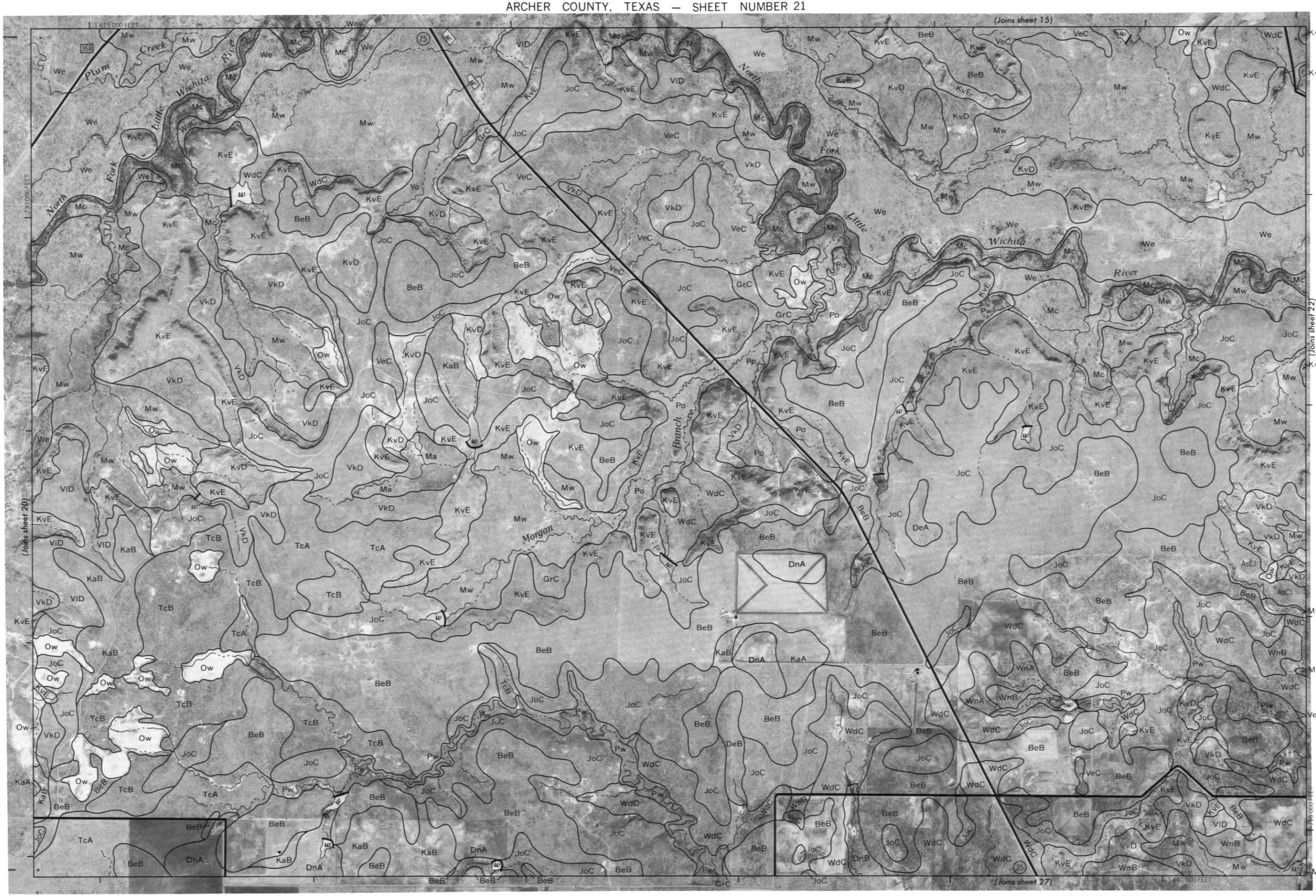
Plum Cr.

Wichita R.

N. Fk. Little Wichita R.

368

388


1 615 000 FEET
1 630 000 FEET
1 640 000 FEET
(Joins sheet 15)
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 27)
Plum Creek
Little Wichita River
North Fork
Little Wichita River
North Fork
Morgan Branch
N
10 000 Feet
5 000
3 Kilometers
2
1
0
Scale - 1:24 000
1 000
2 000
3 000
4 000
5 000

ARCHER COUNTY, TEXAS — SHEET NUMBER 22

22

N

Scale - 1:24 000

10000 Feet 3 Kilometers 2 1 0 .5 0

5000 4000 3000 2000 1000 0

1 715 000 FEET

1 645 000 FEET

1 670 000 FEET

1 730 000 FEET

(Joins sheet 16)

(Joins sheet 21)

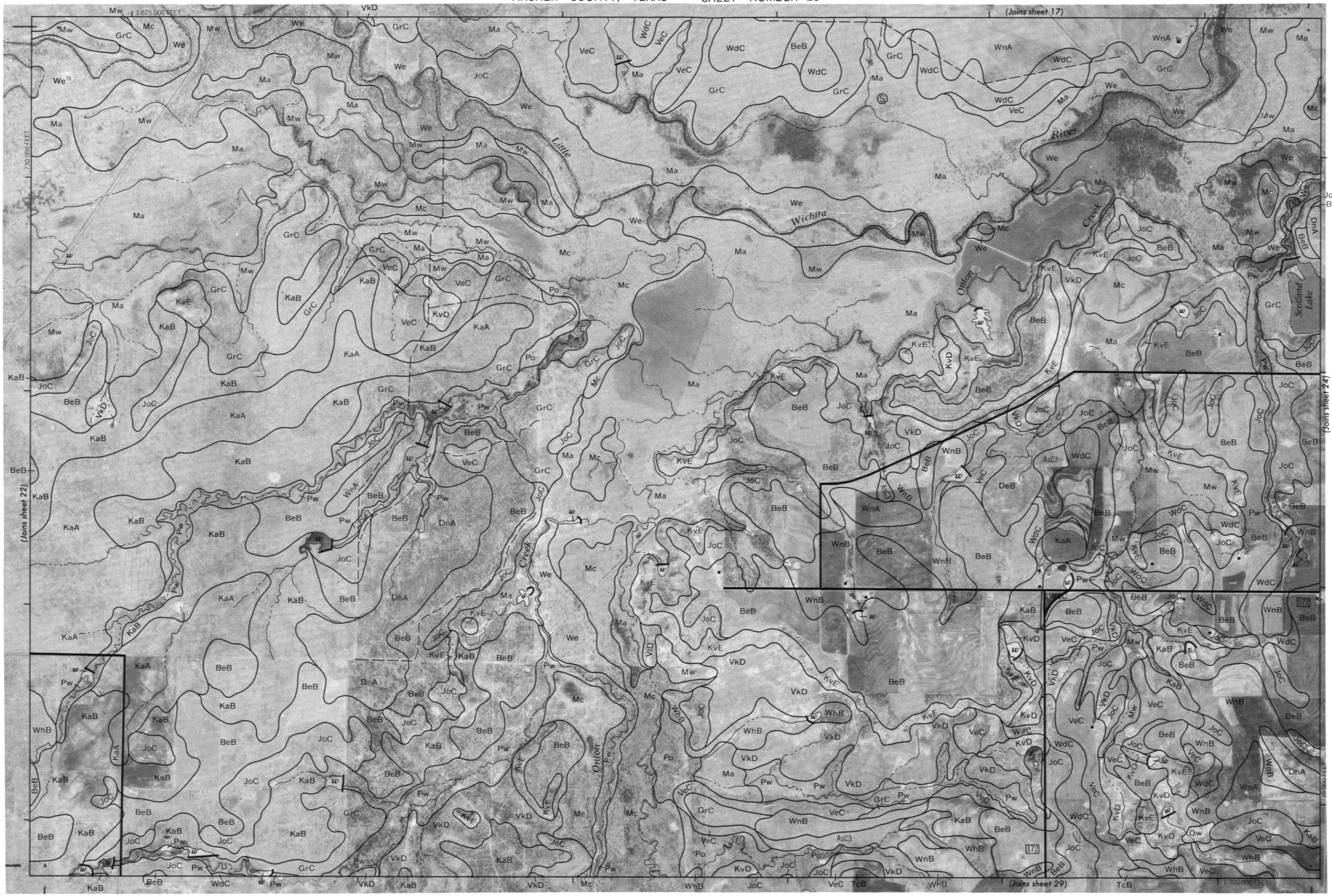
(Joins sheet 23)

(Joins sheet 28)

Wichita River

Little Wichita River

Mule Shoe Ranch (Hdqrs)


1 675 000 FEET
730 000 FEET
(Joins sheet 17)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 29)
1 700 000 FEET
Little Wichita River
Onion Creek
Scotland Lake
23
N
10000 Feet
3 Kilometers
Scale - 1:24 000

24

N

10000 Feet 3 Kilometers

5000 2 1

Scale - 1:24000

0 0

1000 .5

2000

3000 1

4000

5000

(Joins sheet 18)

(Joins sheet 23)

(Joins sheet 30)

1 730 000 FEET

1 715 000 FEET

1 705 000 FEET

LAKE ARROWHEAD

Scotland

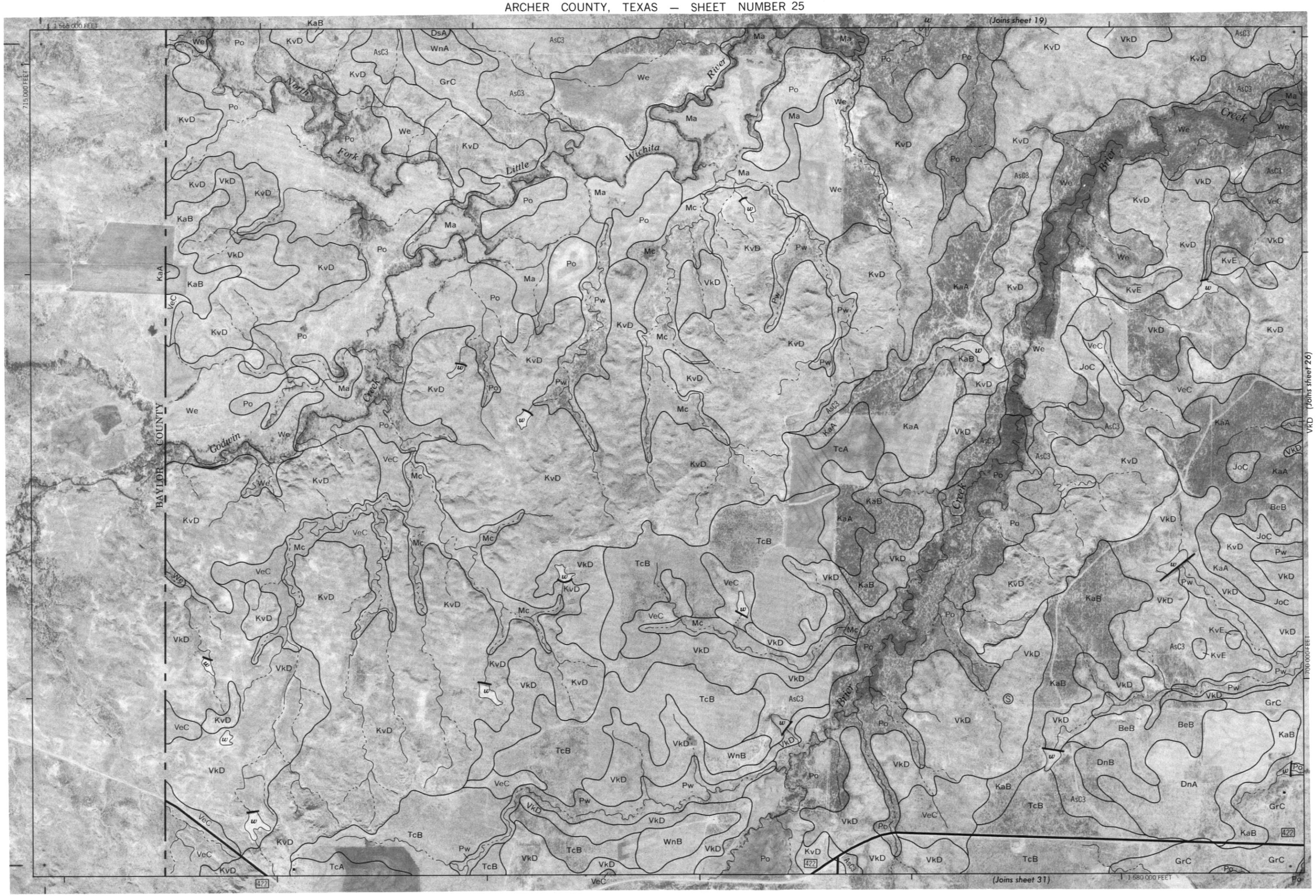
Scotland Lake

Little Post Oak Creek

West

COUNTY

CLAY


1 568 000 FEET
715 000 FEET
(Joins sheet 19)
North Fork Little Wichita River
Brier Creek
Godwin Creek
BAYLOR COUNTY
(Joins sheet 26)
(Joins sheet 31)
1 580 000 FEET
700 000 FEET
422
25
N
10000 Feet
3 Kilometers
2
5000
1
0
1000
2000
3000
4000
5000
.5
Scale - 1:24000

26

N

Scale - 1:24 000

10000 Feet 3 Kilometers

5000 2 1

5000 4000 3000 2000 1000 0 .5 0 1

(Joins sheet 20)

(Joins sheet 25)

(Joins sheet 32)

(Joins sheet 27)

1 610 000 FEET

1 710 000 FEET

1 585 000 FEET

1 700 000 FEET

water

Brier Creek

LAKE KICKAPOO

Kickapoo Creek

Kickapoo Creek

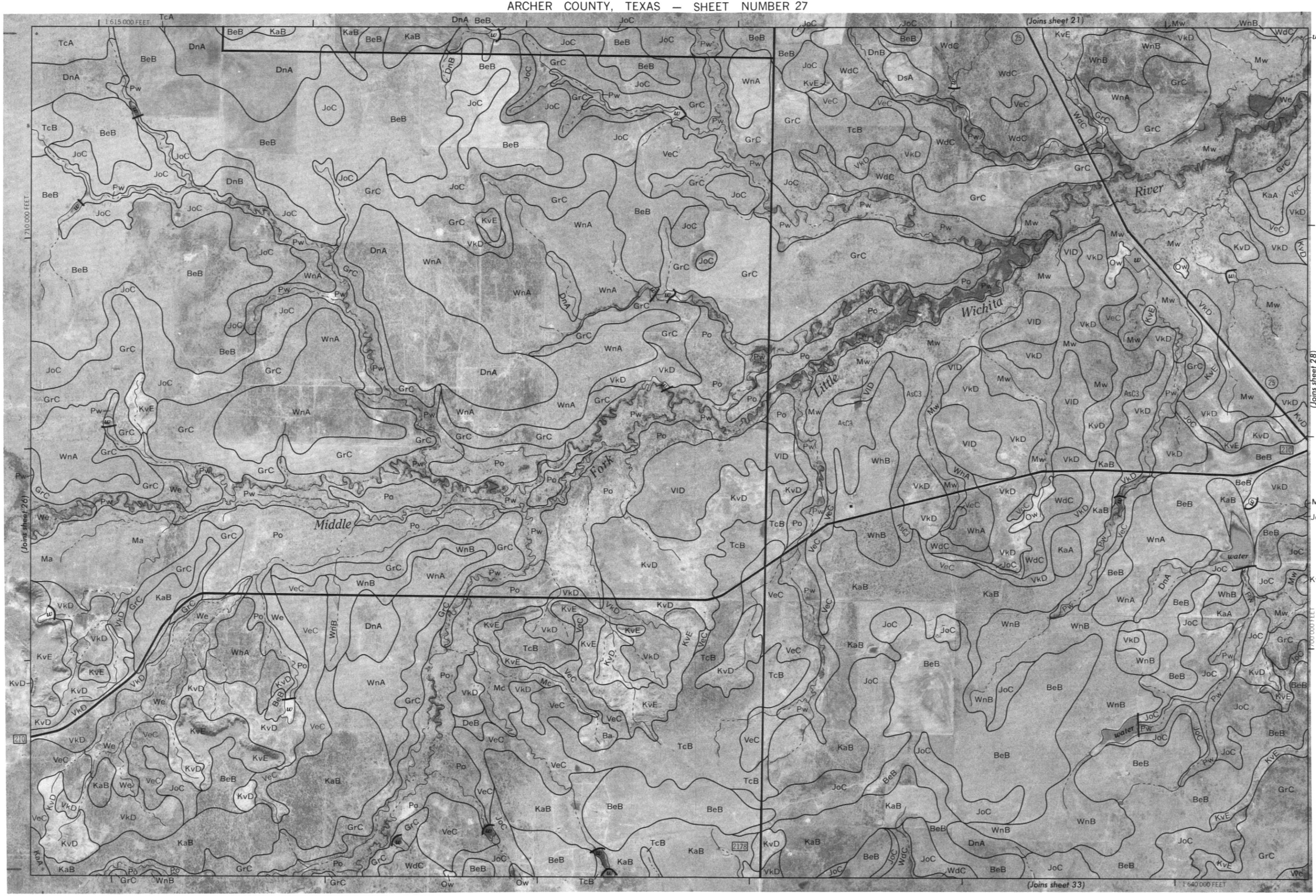
Little Wichita River

Middle Fork

422

210

AsC3 BaA BeB DeB DnA DsA GrC HoA JoC KaA KaB KvD KvE Ma Mc Mw Ow Pw Po TcA TcB VeC VkD WeA WnA WnB


1 615 000 FEET
2 100 000 FEET
(Joins sheet 21)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 33)
1 640 000 FEET
Middle Fork
Little Wichita River
water
27
N
10000 Feet
3 Kilometers
Scale - 1:24000
5000 4000 3000 2000 1000 0
2 1 .5 0 1

28

N

Scale - 1:24 000

10 000 Feet 3 Kilometers 2 1 0 0 1 000 2 000 3 000 4 000 5 000 .5 1

1 670 000 FEET

1 695 000 FEET

1 645 000 FEET

(Joins sheet 22)

(Joins sheet 27)

(Joins sheet 34)

(Joins sheet 29)

River

Wichita

Little

Fork

South

Carver Lake

ARCHER CITY

SEWAGE DISPOSAL

210

281

ARCHER COUNTY, TEXAS — SHEET NUMBER 29

29

N

(Joins sheet 23)

(Joins sheet 30)

(Joins sheet 28)

(Joins sheet 35)

Onion Creek

Little Onion Creek

Dogwood Creek

water

Scale - 1:24000

10000 Feet 5000

3 Kilometers 2 1 0 1

(30)

N

Scale - 1:24 000

10 000 Feet 5 000 0 1 000 2 000 3 000 4 000 5 000

3 Kilometers 2 1 0 .5 1 0

(Joins sheet 24)

(Joins sheet 29)

(Joins sheet 36)

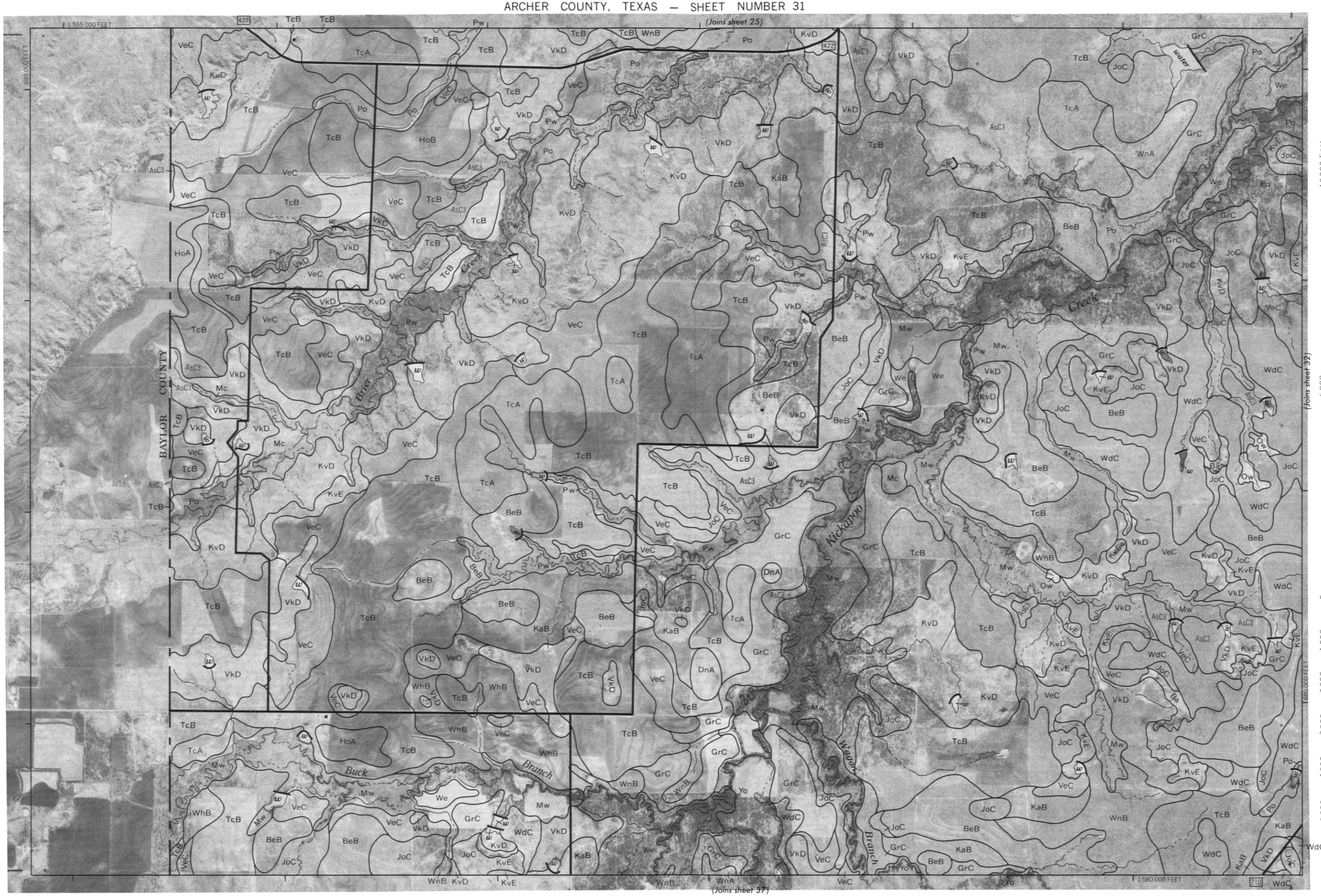
695 000 FEET

730 000 FEET

Windthrost

COUNTY

CLAY


1 555 000 FEET
695 000 FEET
422
(Joins sheet 25)
(Joins sheet 32)
(Joins sheet 37)
1 580 000 FEET
210
BAYLOR COUNTY
Brier Creek
Buck Creek
Kickapoo Creek
Wagon Creek
Branch
Branch
water
N
10000 Feet
3 Kilometers
2
1
0
5000
0
1000
2000
3000
4000
5000
.5
1
Scale - 1:24000

N

Scale - 1:24 000

10 000 Feet 5 000 0

3 Kilometers 2 1 0

(Joins sheet 26)

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 38)

1 610 000 FEET

695 000 FEET

1 580 000 FEET

1 585 000 FEET

Kickapoo Cr.

Little Wichita River

Middle Fork

210 422 210 2178 2178

ARCHER COUNTY, TEXAS — SHEET NUMBER 33

33

N

Scale - 1:24000

10000 Feet 5000 0 1000 2000 3000 4000 5000

3 Kilometers 2 1 0 .5 1

1 615 000 FEET

1 640 000 FEET

2178

(Joins sheet 27)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 39)

Radio Facility

water

Wichita River

Little Wichita River

South Fork

KaA KaB KvD KvE Ma Mw Ow Po TcA TcB VeC VkD WdC We WhA WhB WnA WnB

34

N

10000 Feet 3 Kilometers

5000 2

Scale - 1:24000

0 0

1000 .5

2000 1

3000

4000

5000

(Joins sheet 28)

(Joins sheet 33)

(Joins sheet 40)

(Joins sheet 35)

1:670000 FEET

1:675000 FEET

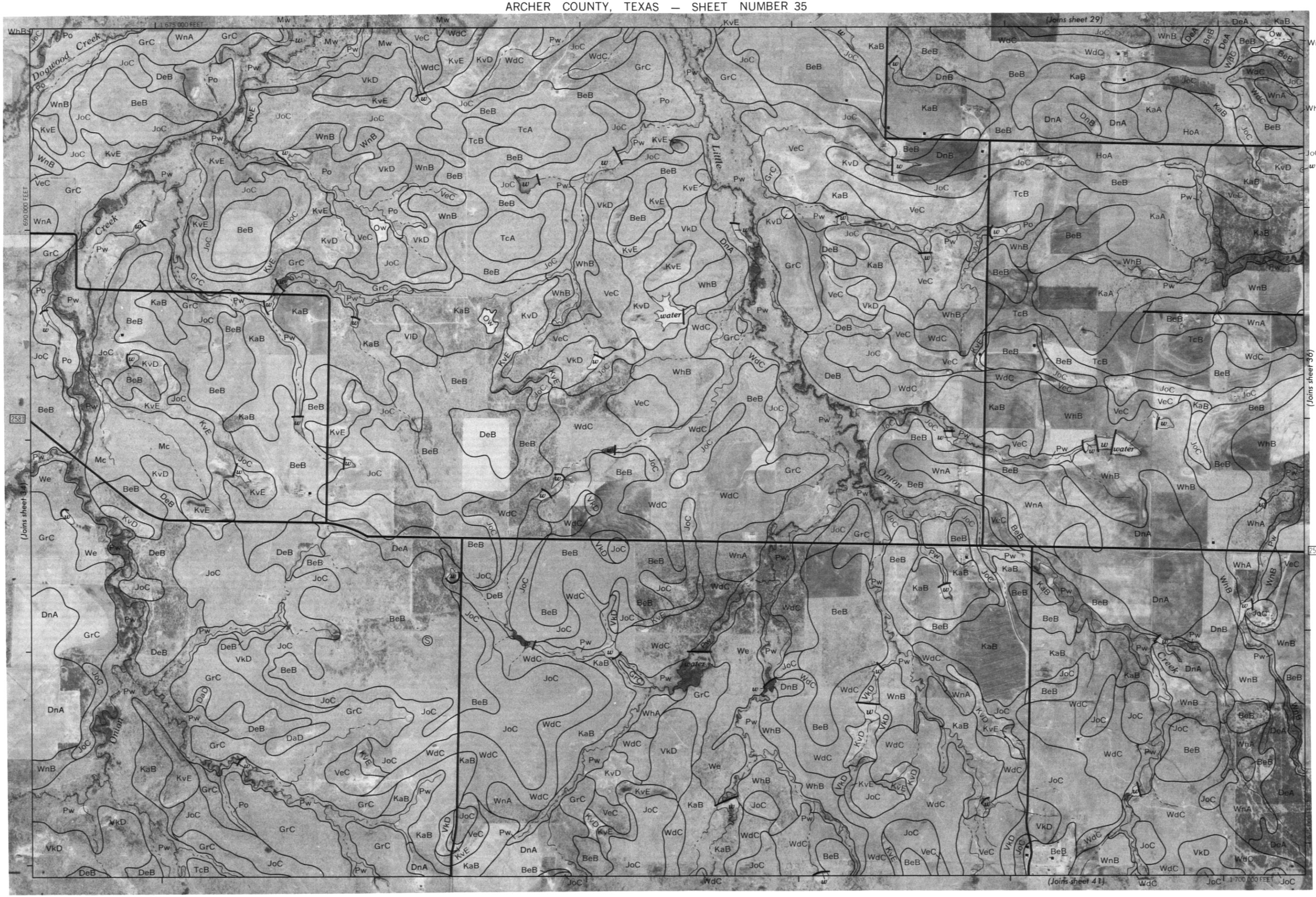
1:645000 FEET

Dogwood Creek

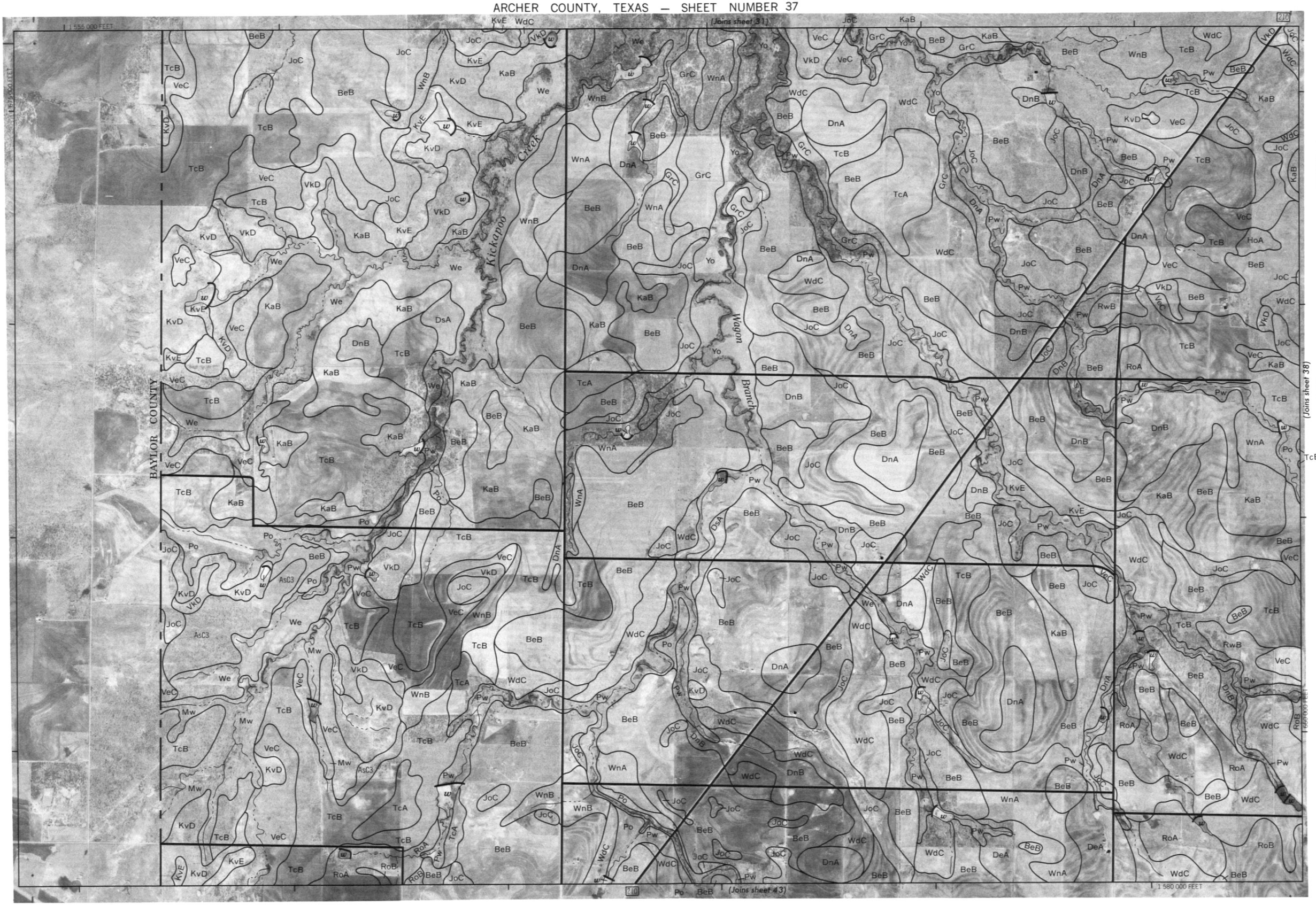
Dogwood Creek

Onion Creek

water


Dogwood Creek
Little Onion Creek
Onion Creek
water
(Joins sheet 29)
(Joins sheet 36)
(Joins sheet 34)
(Joins sheet 41)
1 575 000 FEET
690 000 FEET
1 700 000 FEET
2581
N
10000 Feet
3 Kilometers
5 000
2
1
0
.5
Scale - 1:24000


N
10 000 Feet
3 Kilometers
Scale - 1:24 000
(Joins sheet 30)
(Joins sheet 35)
(Joins sheet 42)
CLAY COUNTY
water
1 705 000 FEET
1 730 000 FEET
281
2581



37

N

10000 Feet 3 Kilometers

Scale - 1:24000

5000 4000 3000 2000 1000 0 1 2 .5 0 1

N

Scale - 1:24000

10000 Feet 5000 0 1000 2000 3000 4000 5000

3 Kilometers 2 1 0 .5 1

1 610 000 FEET

1 660 000 FEET

1 585 000 FEET

2178

(Joins sheet 32)

(Joins sheet 37)

(Joins sheet 44)

(Joins sheet 39)

Little Wichita River

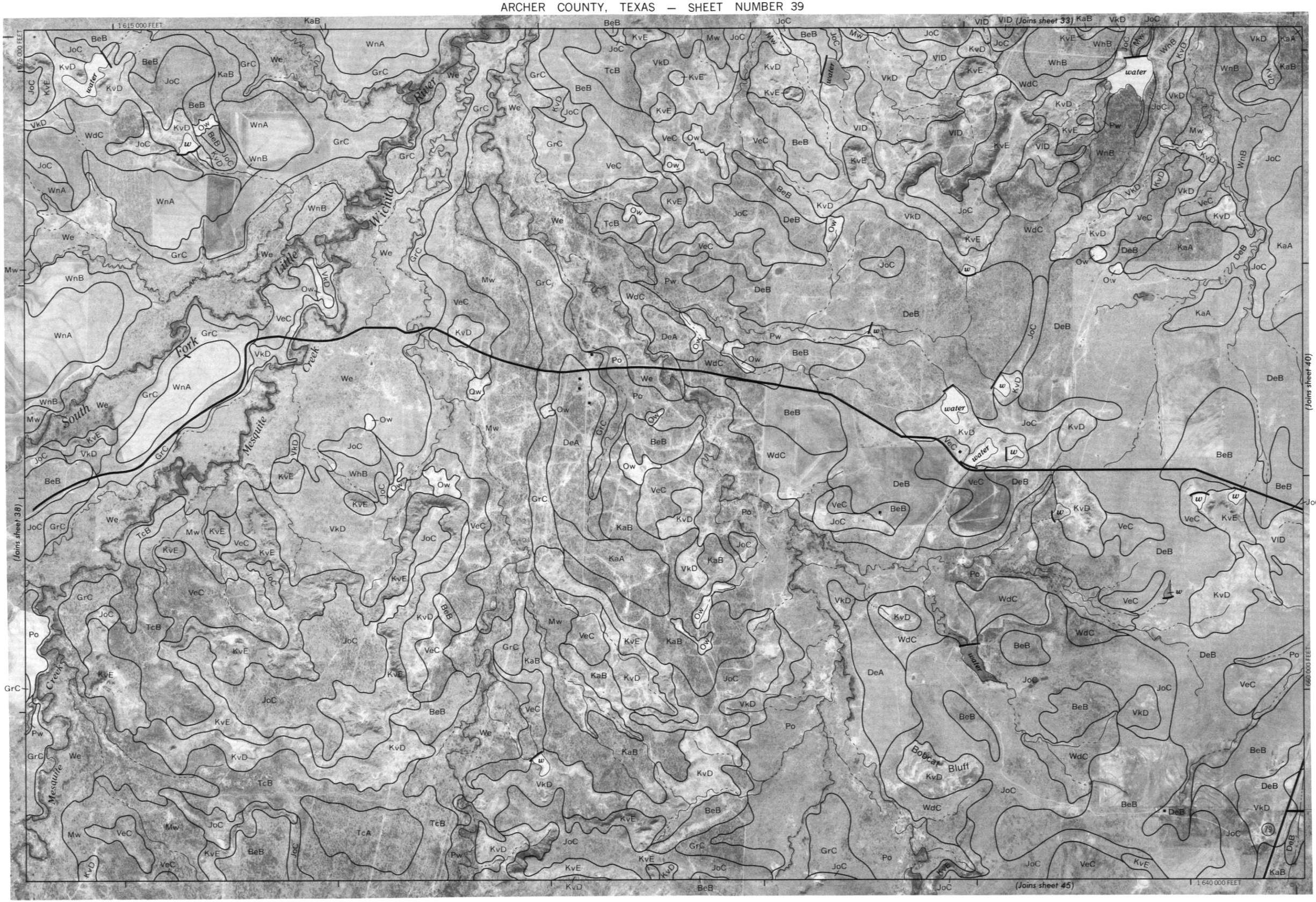
Middle Fork Little Wichita River

Table Branch

South Fork Little Wichita River

Mesquite Cr.

water


1 615 000 FEET
1 640 000 FEET
(Joins sheet 33)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 45)
Wichita River
Little Fork
South Fork
Mesquite Creek
Bobcat Bluff
water
N
Scale - 1:24000
10000 Feet
3 Kilometers

40

N

Scale - 1:24 000

10000 Feet 3 Kilometers 2 1 0 5000 0 1000 .5 2000 3000 1 4000 5000

660 000 FEET

1 645 000 FEET

1 650 000 FEET

670 000 FEET

79 (Joins sheet 34)

(Joins sheet 39)

(Joins sheet 41)

(Joins sheet 46)

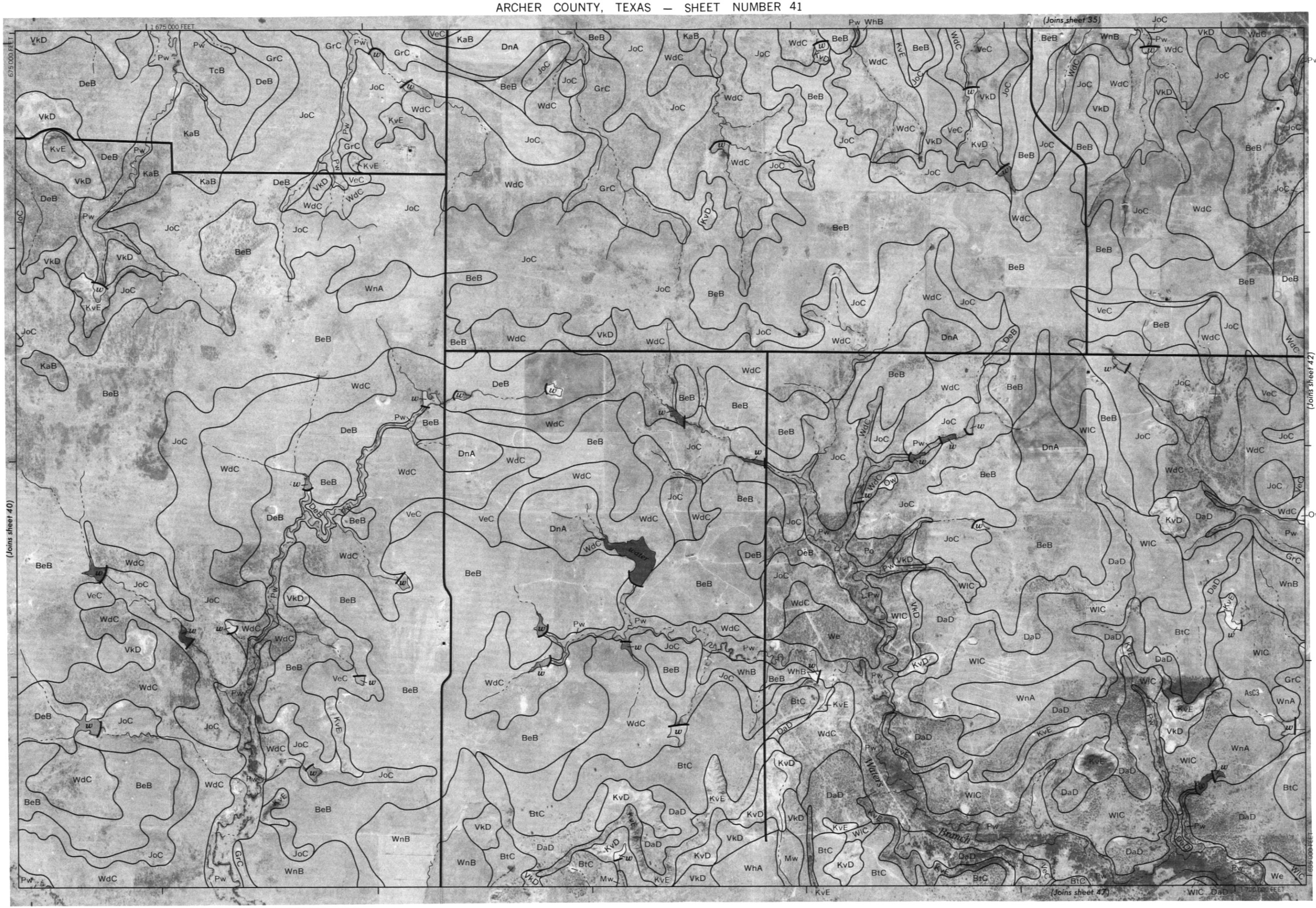
Anarene

Dogwood Creek

Onion Creek

water

VkD WhB KaA JoC TcB DnA TcA VeC KvD Po WnA DeB BeB GrC KaB WhA Pw Ow KvE VID WnB VkD


1 675 000 FEET
675 000 FEET
(Joins sheet 35)
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 47)
1 685 000 FEET
N
10000 Feet
3 Kilometers
Scale - 1:24 000
5000
4000
3000
2000
1000
0
.5
1
2
Water
Waters
Branch

N

Scale - 1:24000

10000 Feet 3 Kilometers 5000 2 1 0 1000 .5 0 2000 3000 1 4000 5000

685,000 FEET

1 705 000 FEET

730 000 FEET

670,000 FEET

Pw (Joins sheet 36)

(Joins sheet 41)

(Joins sheet 48)

CLAY COUNTY

CLAY COUNTY
JACK COUNTY

Darnell

Branch

water

ARCHER COUNTY, TEXAS — SHEET NUMBER 43

43

N

10000 Feet 3 Kilometers

Scale - 1:24 000

(44)

N

Scale - 1:24 000

10000 Feet 3 Kilometers 5000 2 1 0 0 1000 .5 2000 3000 1 4000 5000

(Joins sheet 38)

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 49, inset A)

1 610 000 FEET

1 585 000 FEET

LAKE COOPER

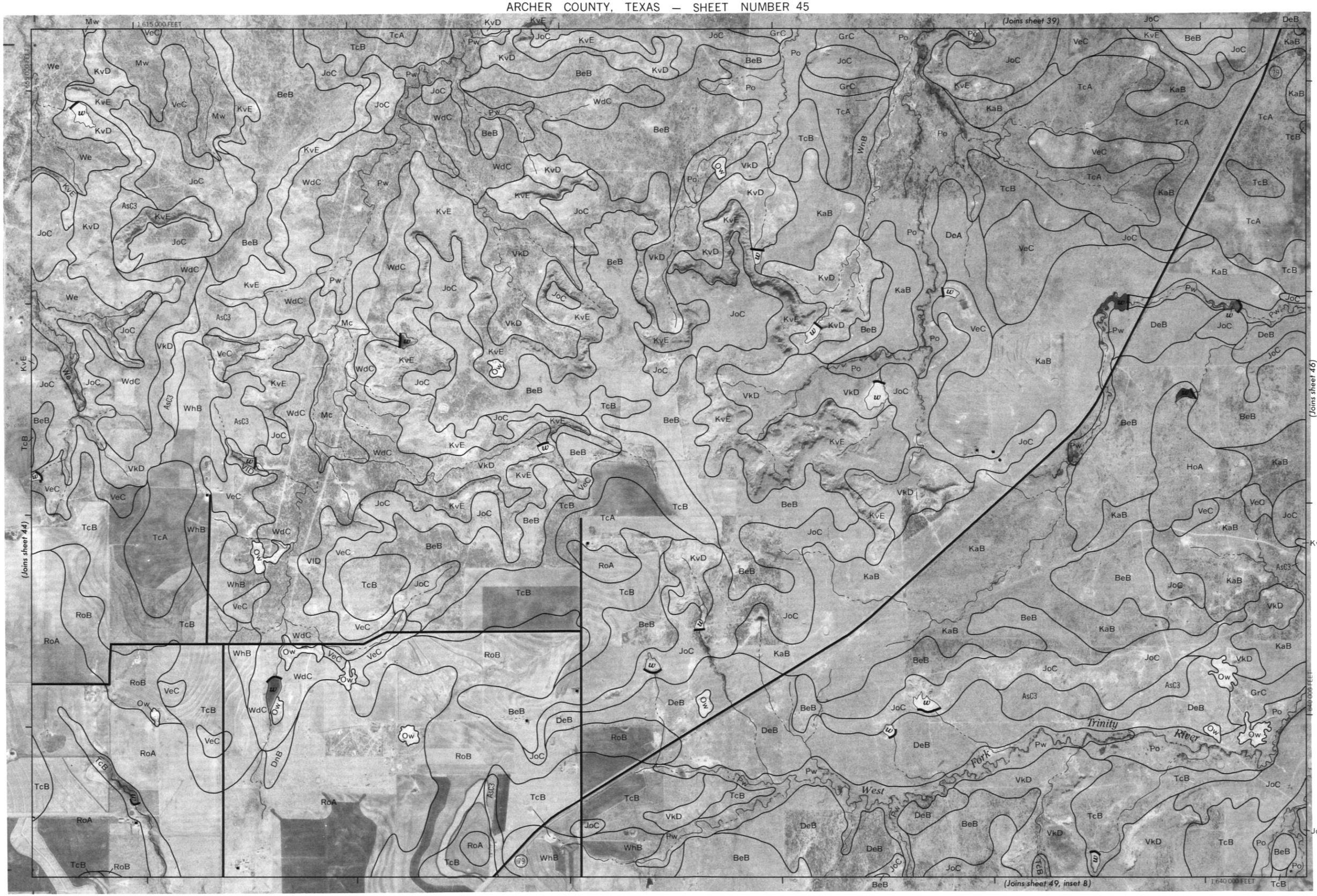
OLNEY

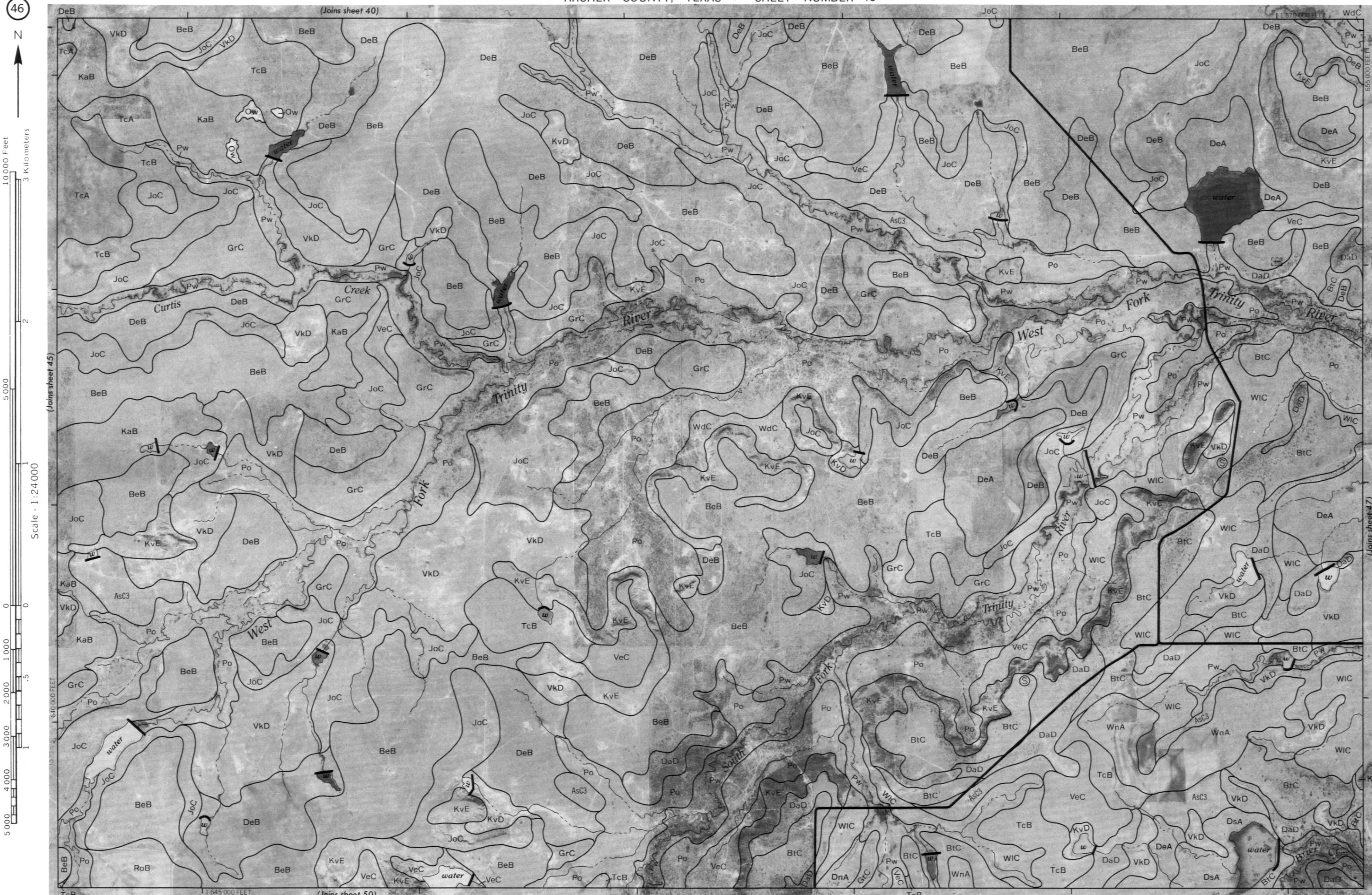
Mesquite Creek

Bear Creek

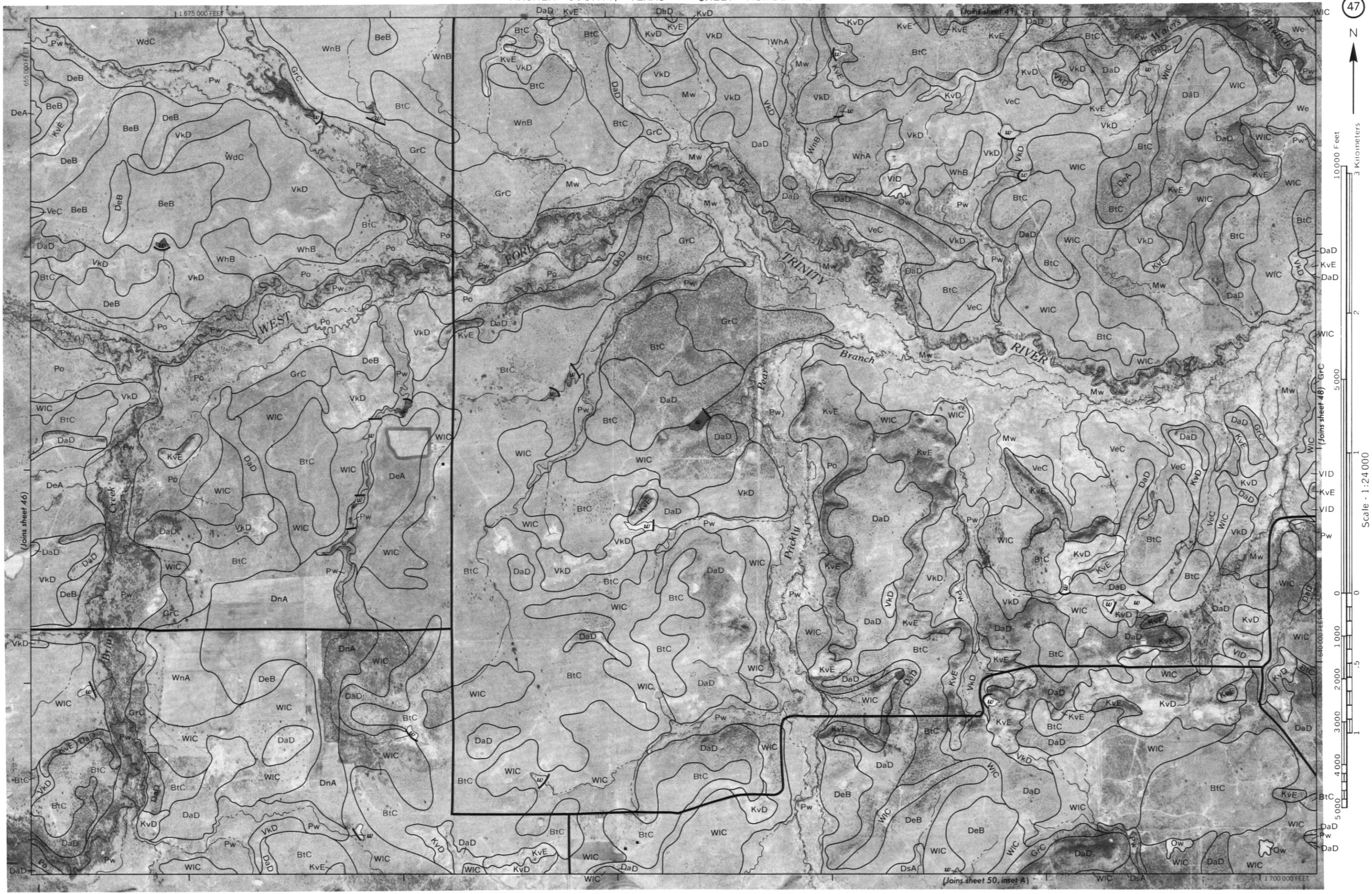
water

2178


1 615 000 FEET
655 000 FEET
(Joins sheet 39)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 49, inset 8)
1 640 000 FEET
Trinity River
West Fork
Scale - 1:24 000
10 000 Feet
3 Kilometers
5 000
2 000
1 000
0
.5
1
2
3 000
4 000
5 000
N
45
79


46
N
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 50)
10 000 Feet
3 Kilometers
Scale - 1:24 000
5000
1000
2000
3000
4000
0
1
.5
2
640 000 FEET
1 645 000 FEET
655 000 FEET
Curtis Creek
West Fork Trinity River
South Fork
water

ARCHER COUNTY, TEXAS — SHEET NUMBER 47



48

N

Scale - 1:24 000

10 000 Feet 5 000 0 1 000 2 000 3 000 4 000 5 000

3 Kilometers 2 1 0 .5 1

1 730 000 FEET

650 000 FEET

640 000 FEET

1 705 000 FEET

(Joins sheet 42)

(Joins sheet 47)

(Joins sheet 50, inset B)

JACK COUNTY

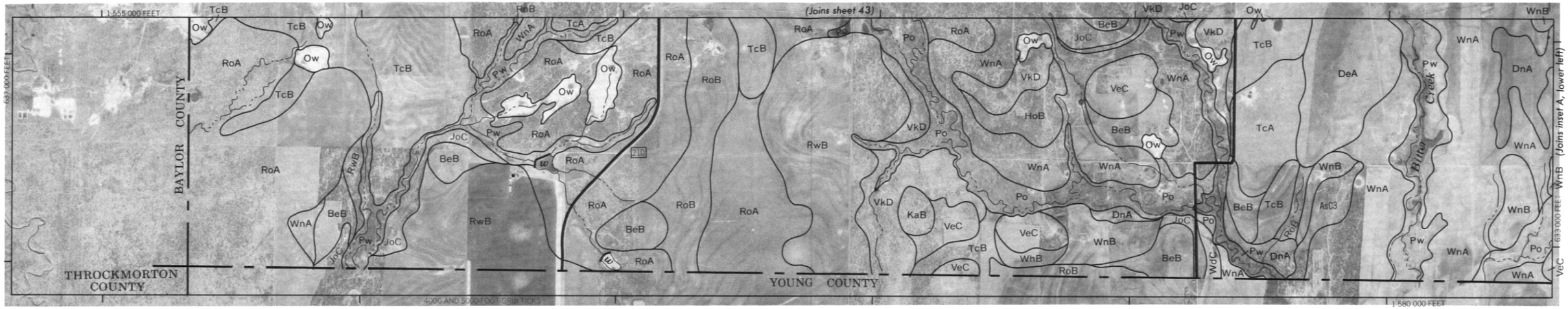
Gap Mountain

West Fork Trinity River

Darnell Branch

Brushy Creek

WIC DaD VeC Pw We BtC GrC Mw KvE VkD DeB DeA KvD VID Wc Yo



N

10,000 Feet 5,000 0

3 Kilometers 2 1 0

Scale - 1:24000

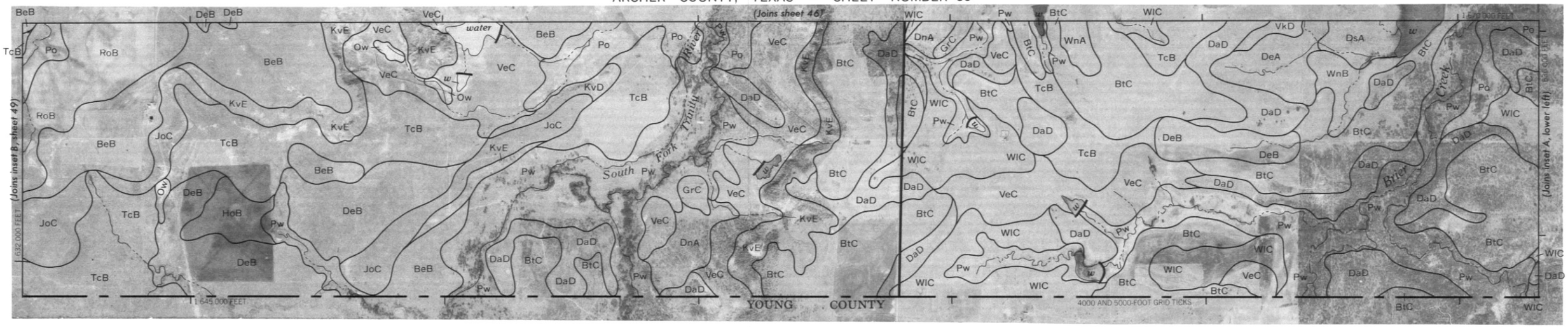
50

N

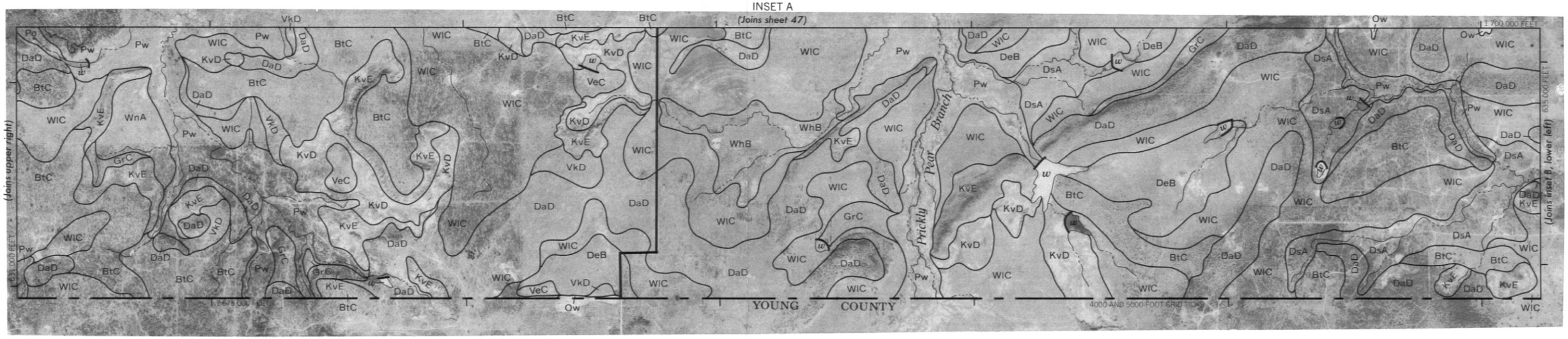
10000 Feet 3 Kilometers

5000 2 1 0 0 1000 2000 3000 4000 5000 .5 1

Scale - 1:24000



INSET A



INSET B